Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XL. NEW YORK, SATURDAY, NOVEMBER 15, 1902. No. 20.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

114 LIBERTY STREET, NEW YORK.

PUBLISHED WEEKLY.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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ELECTRICAL WORLD AND ENGINEER.

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Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, NOVEMBER 15, 1902.

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GENIUS AT ITS PRIME.

The relative youth of the men engaged in electrical development has again been brought home forcibly by the sad and sudden death of Prof. Sidney H. Short, of whose funeral service in New York note is made this week. Here was a man who had devoted all his active life to electric traction and whose car, the "Joseph Henry," in Denver fifteen years ago, on the streets, was one of the harbingers of the new development; yet when he was stricken down the other day in London, he was barely forty-four years. In the brief interval from Denver to London, he had seen and had helped bring into being a new art, the capitalization of which in this country has reached about $2,500,000,000, and he was busily engaged pushing a proportionate and kindred growth in England. In many ways, and in traction conspicuously, Prof. Short was an integral part of these electric times; and it is not to be forgotten that he was one of the first to do successful work in telephony.

Nikola Tesla has said that no inventor is good for anything after forty-five; but while we may demur to this dictum, even in behalf of its author, we cannot help feeling that in the full and rounded career of Prof. Short, there is some compensation and offset to his untimely decease, regarded professionally. Had he lived he would have tried to fill up many deficiencies that he knew still to exist in the electrical industries, and his ripened business sense would have found larger opportunity. He was already intent on automobilism, and would doubtless have scored in that direction. But after all is said and done, it has been given to few men so young to do so much, and in his tragic taking-off, the parallel can only be found in the death of poor Dana Greene. In such careers there is lesson and encouragement for the younger men. Sidney Short began electric traction, indeed, with disheartening failure, and with desperate courage sought to work out the feasibility and practicability of the series method. He was alert enough and shrewd and flexible enough when he detected for us all the inherent defects of that fundamental method, to make himself one of the strong figures in the multiple art upon which the whole fabric of electric traction is now built up. Moreover, having made his record here, he was again able to fit himself into the difficult new conditions awaiting any American who transplants himself into England, and as an exponent of what our good cousins across the Atlantic like to call, "the American invasion," he was a notable and decided success. It is said that the concern with which he became associated has been doing the largest electric railway work in England; and there can be no question as to the happy results that have flowed from that combination of American experience with British capital and enterprise. We are glad to record here the prompt appreciation given in his case, as in so many others, by Englishmen, of American ability and push; and in reality they were but approving one of their own race and stock.

ELECTRICAL DEVELOPMENT AT THE "SOO."

The erection of an electrical generating plant with a capacity of 32,000 kilowatts is not an every-day affair, even in the present advanced stage of the electrical art. The water-power plant of this capacity, which is under construction at Sault Ste. Marie, Mich., has perhaps not attracted the attention in the electrical field which its size would warrant. The various articles which have appeared in recent issues of this paper, have served to call the attention of elec-

trical men to the importance of this water-power plant, which is exceeded in size only by that at Niagara. The generating station at the "Soo" differs from other large generating stations recently erected in that the units are relatively smaller, being of only 400 kilowatts capacity each. As eighty of these are required to make up the 32,000-kw capacity of the station, the size of the generating plant runs into astounding figures, the length being something over a quarter of a mile. The difficulty of getting large turbine units to operate on as low a head as 20 feet seems to have been the factor limiting the size of the generating units. Although in some ways the smallness of these units has made the engineering of the plant very simple as presenting no problems that have not been solved before, there is one respect in which there has been opportunity for pioneer work, and that is in designing a comprehensive scheme of switchboard control. This involved placing easily within the reach of one man the electrical controlling apparatus for forty electrical units, each of which, while being small as compared with some of the largest generators now built, is nevertheless sufficiently large that with the usual size of switchboard panel for the direct hand control of each generator circuit, a board would have been required, so long as to make supervision of the entire board by one man impossible, and involving besides an enormous amount of copper in the power house for generator leads and bus-bars. The problem has been solved by the use of edgewise instruments and very narrow switchboard panels, with electrically-operated switches, so that no main circuits are taken to the switchboard. Incidentally, the use of the edgewise type of instrument has made possible a very neat scheme for enabling the attendant to see at a glance the relative load and the relative field current on all the generators operated. It is notable also that the plan contemplates the use of circuit-breaking switches, operated by solenoids, the switches being held closed as long as current flows in the solenoids.

On account of the distance of Sault Ste. Marie from any large industrial center, and its location favorable to cheap water transportation, the electrical output is more likely to be all utilized near that point than transmitted a long distance. The industries naturally seeking the Sault Ste. Marie power will be those requiring large quantities of electrical energy, such as for the operation of electric furnaces and in electrochemical work. In fact, no small part of the output of the generating plant has already been contracted for, to be used in calcium carbide furnaces. The industrial development of the Canadian "Soo" has been marvelous the past five years, under the financial cultivation of the enterprising Clergue Syndicate, and with the approaching completion of the great water-power plant on the American side by the same interest, the electrical development there is likely to be no less impressive than the collection of miscellaneous, but closely allied industries on the Canadian side. For the reasons spoken of, the American "Soo" development is likely to be most interesting in an electrical way, as indeed it is already proving to be.

TERMINOLOGY OF PRIMARY AND SECONDARY BATTERY ELECTRODES.

The article by Professor Marsh on this subject, at page 777, draws attention to the confusion in terminology existing on the subject of the polarity of voltaic battery electrodes. We agree with this article that the terminology should be revised and simplified. As usual, the confusion in terminology is associated with a confusion in ideas upon the nature of polarity. The literature upon the subject is copious and distracting. He must needs be a learned man who is familiar with all that has been written upon the subject; but he will not thereby necessarily be a wise man, or able to decide so vexed a question. It is only necessary to read the well and long established text-book, Fleeming Jenkin's "Electricity and Magnetism," with reference to the polarity of the plates in a voltaic cell, to recognize the confusion which has existed since the date at which that book was written. An adequate understanding of the theory of polarity there presented is almost as difficult as that of fourth dimensional space. A battery plate is indicated as being, say, positive under the surface of the electrolyte, while above that surface the same plate is represented as negative; or, if not the plate itself, at least the wire connected thereto.

This anomalous conditon of theory, in which an electrode is called positive from an external and negative from an internal standpoint, was introduced partly to accord with some perplexing experimental voltaic phenomena, and partly because the relations of two plates forming a voltaic couple were always studied with respect to each other, and not each independently with respect to the electrolyte, its immediate environment. The Nernst theory of solution pressures, changes this state of affairs and presents a prospect of the conditions between any plate and its surrounding electrolyte, without reference to any other plate dipping in the same electrolyte. According to this more modern theory, as explained by Professor Marsh, the polarity of a battery plate or electrode can be properly regarded as one and the same, both inside and outside of the solution. The zinc plate of a Daniell cell may thus be regarded as a negative plate, and also as a negative pole of the cell; while the copper plate may similarly be regarded as both the positive pole and the positive plate.

According to generally prevailing doctrines, the copper electrode forms the positive pole on top, but the negative plate below, and this is an unnecessary complication. According to the hitherto prevalent view, this plate receives current below the solution, and is consequently there negative, while it delivers current above the solution and is, therefore, positive in that region. The proposed plan would make the solution or electrolyte of the cell a sort of neutral ground in respect to which one electrode is wholly positive, both inside and out; while the other electrode is wholly negative, both inside and out. It is clear that this is a matter of language and terminology, as distinguished from a matter involving the phenomena of the cell. But the gain would be in simplicity, and a theory freed from complications. We should then have the peroxide electrode of a secondary cell the positive pole and plate, such as they are now termed in commerce, instead of having a conflict between commercial and technical phraseology.

ALTERNATING-CURRENT TELEGRAPHY.

The serial article of Mr. E. F. Northrup, appearing in this and in the preceding number, contains data interesting to the telegraphist. Alternating-current telegraphy forms a sort of connecting link, or intermediate step, between telephony on the one hand, and power transmission on the other. Thus, the frequency of power transmission is commonly 25 cycles per second. The important frequencies of telephony are supposed to range from 150 to 1,000 cycles per second, while alternating-current telegraphy steps between them at 100 cycles per second. An advantage of alternating-current telegraphy is that it lends itself to calculation much better than battery-impulse telegraphy. The battery impulses that are sent into a long telegraph line, enter as waves of the rectangular type. As they run along the line

their angles or corners are gradually rounded off, until, at the distant end, they are undistinguishable from simple sine waves, and the automatic rounding-off process is very difficult to calculate. With, however, simple sinusoidal waves sent into the line by an alternator at the sending end, the waves run along unchanged in form, although diminishing in amplitude, until they make their appearance as sinusoids at the receiving end. This simplifies the calculation.

In computing the current amplitude and phase along power-transmission lines, it is usually sufficient to assume all the capacity of the line as aggregated into an ideal condenser at the center. By this device the computation is much facilitated. But with the greater lengths and higher frequencies of telephony this approximation will not suffice; and hyperbolic formulæ are the next simplest keys to unlock the phenomena. If the hyperbolic analysis is not used, the formulæ becomes long and tedious, but ultimately equivalent. Alternating-current telegraphy shares with telephony the hyperbolic method of analysis. Some of the practical results contained in Mr. Northrup's article are very interesting. Thus the range of effective duplex between received current ratios of one-sixth and one-tenth the sending current, is a generalization that, if applicable to all types of commercial alternating-current telegraph apparatus, cannot fail to be useful to the engineer. Such a generalization has not hitherto been possible with battery impulse telegraphy.

LONG DISTANCE WIRELESS TELEGRAPHY

One of our London contemporaries contains a report with comment, abstracted in the Digest this week, upon the recent cruise of Marconi on the Carlo Alberto, experimenting with long distance messages. The statement is made that good working was obtained up to a distance of 1,200 kilometers—about 750 miles—which has been already reported in our columns. If, as our contemporary intimates, some of these very messages were caught by independent instruments in various parts of England, the case for a clean transmission seems to be well made out, and, in fact, with an ample supply of energy at the sending station there is no special reason for doubting the feat. We have steadily maintained that lack of energy has been a fruitful source of failure in wireless experiments. One cannot expect great results from insufficient apparatus, and when the working energy is not directed, but radiated from a point, a very large "factor of safety" is called for. So little is yet known of the actual mechanism of the wave transmission concerned that it is idle to speculate on the probable maximum distance to which readable signals can be sent, but it would seem to be merely a question of available energy. This statement may or may not imply an indefinite distance. An antepenult Greek philosopher once remarked that he could move the earth single-handed, given a long enough lever and a suitable fulcrum, but it is not of record that he actually did shake things up as per programme.

The great station at Poldhu has quite certainly shown itself capable of sending signals to a distance greatly in excess of anything previously recorded. From a practical standpoint the vital thing is the distance over which transmission of signals is reliable, and the account we are considering appears to show that this is very much inferior to the maximum distance. Both these and other experiments seem to show lack of certainty in the working, depending upon factors as yet rather imperfectly comprehended. Atmospheric conditions assuredly play an important part here, and it is a common experience of transatlantic travel to find the wireless not working satisfactorily, while at times remarkable results are achieved. At moderate range most of the difficulties seem to disappear. The energy supplied must apparently be great enough to drive through unfavorable conditions of unknown kind and extent in order to secure anything like complete reliability. We note that our contemporary lays great stress on the fact that some of the Poldhu messages were received on independent apparatus, as evidence that wireless telegraphy will lack the secrecy that would be commercially desirable. We do not see that such is the logical conclusion, for the object of the experiments was to get results quite irrespective of syntonism. Just how far it will be possible to develop syntonic apparatus using very large amounts of energy remains to be seen. It is certainly within the bounds of possibility to attain at least syntonism to a moderate extent enough to prevent the interference of stations with slightly overlapping spheres of influence. Whether a very powerful long distance station could be kept from interference with numerous local stations is another question, but aside from the annoyance to the local stations, no harm would result from lack of complete syntonism. One can, and ordinarily would, use code for wireless messages, as for cable dispatches, and the mere ability of meddlesome persons to pick up wireless messages is not a matter of importance.

The difficulties are enormous, however, for such syntonic working as would obviate the possibility of malicious interference with the system. Indeed, such syntonism is theoretically impossible, for any possible range of frequency can be duplicated. A military interference station industriously worked, say, at Calais, could probably be made to break down the wireless transmission of messages for any but the shortest distances all over the United Kingdom and the surrounding waters. At very short range—merely a few miles—far distant from the interfering station, the local supply of energy could be made to break through the interference, but syntonism would be of small use against an intelligent attack. With these obvious failings we still feel confident that wireless telegraphy is capable of very great practical use, less in supplanting than in supplementing our present means of communication. If we remember aright, the telephone in its early days was booked to drive ordinary telegraphy off the face of the planet; but, although the telephone is on every desk, Morse still holds its own. And so with wireless telegraphy—when the war of rival systems is over and the smoke of battle has blown away, the survivors will come to their own, not to the undisputed inheritance of the whole earth, but to such reasonable part of it as the circumstances warrant. Meanwhile, there is need for a deal of hard work, for, truth to tell, the whole subject is in a condition of rank empiricism—like the early science of medicine. It reminds us of the historic days when they used to administer half a gallon of the infusion of Peruvian bark to do the work of a few grains of quinine. Every new art has to pass through such a stage, and should be not in the least discredited thereby. Marconi is following the path of wisdom in doing a deal of hard work, and talking very little—success attend his efforts. In the meantime, we most sincerely hope that Congress will turn a deaf ear—for some years at least—to the bureaucrats who would have the infant art consigned to their tender care on the plea that if not governmentally supervised it may have an unruly growth. In view of the incompetency thus far displayed by the Navy Department in its relations with wireless telegraphy, the suggestion above referred to comes with ill grace from one of its Bureau chiefs.

Funeral Service Over the Late Prof. S. H. Short.

The remains of the late Prof. Sidney H. Short reached this country on the "St. Louis" on Sunday last, and on Tuesday, November 11, at 3:30 P. M., a funeral service was conducted by the Rev. Minot J. Savage, at the Church of the Messiah, New York City. The family of the deceased were present and a number of friends, and a great many flowers were received from distant cities. The pall bearers were Judge W. B. Sanders and Howard H. Burgess, of Cleveland; Benjamin Graham, of Cuyler & Morgan, an associate wtih Prof. Short in the pioneer road at Rochester, N. Y.; H. McL. Harding, president of the United Telpherage Company; James H. McGraw, of the *Street Railway Journal;* T. C. Martin of ELECTRICAL WORLD AND ENGINEER, and R. W. Pope, secretary American Institute of Electrical Engineers. After the service, in which Dr. Savage referred felicitously to the public services of him who was taken away so soon, the body was taken by special train to Woodlawn Cemetery, accompanied by the family and many friends. It was there placed in the receiving vault to await the selection of a burial lot.

Chicago Drainage Canal Power.

A contest has recently been going on in the courts between the trustees of the sanitary district of Chicago and the Gaylord syndicate, regarding the ownership of some of the water power made available in the vicinity of Joliet by the opening of the Chicago drainage canal. The Gaylord syndicate attempted to take advantage of the old State law, which enabled anyone desiring to start a grist mill to condemn land along the river. The trustees of the drainage canal had previously started to build a dam and water-power plant, but work was stopped, and while this was being done, the Gaylord syndicate stepped in and tried to condemn land enough to take the water power away from the sanitary district. Judge Hilscher, of the Circuit Court of Will County, on November 7 dismissed the suit brought for condemnation by the syndicate, on the grounds that the syndicate did not desire the land for public use. The text of the decision was, in part, as follows: "It is clearly the duty of the court in this kind of case to determine whether the purpose of the taking is for a public or private use. If the purpose is, in fact, for a private use, though under cover of a pretense for a public use, then it is the duty of the court to deny the exercise of the right of eminent domain. After a careful study of the petition, the evidence and the authorities cited, as well as the mill act and the sanitary district act, and of the well-known industrial conditions of which it is the duty of the court to take notice, I am led to the unavoidable conclusion that the purpose for which condemnation is sought in this case is not to acquire private property for a public use, but is to acquire public property for a private use."

Conditions of Award for the John Fritz Medal.

Last week we reported the proceedings connected with the foundation of the John Fritz medal and the banquet given to celebrate its creation and the eightieth birthday of Mr. Fritz. The following rules were adopted by the General Committee, to govern the foundation of the medal:

1. The John Fritz medal was established by the professional associates and friends of John Fritz, of Bethlehem, Pa., U. S. A., August 21, 1902, his eightieth birthday, to perpetuate the memory of his achievements in industrial progress.

2. The medal shall be awarded for notable scientific or industrial achievement. There shall be no restriction on account of nationality or sex.

3. The medal shall be of gold and shall be accompanied by an engraved certificate, which shall recite the origin of the medal and the specific achievement for which the award is made. Such certificate shall be signed by the chairman and secretary of the board of award.

4. The medal may be awarded annually, but not oftener.

5. No award of the medal shall be made to any one whose eligibility to the distinction has not been under consideration by the board of award for at least one year.

6. Awards shall be made by a board of 16, appointed or chosen in equal numbers from the membership of the four national societies, the American Society of Civil Engineers; the American Institute of Mining Engineers; the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. The governing bodies of each of these societies shall be requested to appoint from its membership one representative who shall hold office for one year, one for two years, one for three years, and one for four years, and each succeeding year to appoint one member to serve for four years.

7. In case of failure of any of the national societies to make the original appointments as requested, the selection of representatives from its members shall be made by those appointed from the other societies, and should any future vacancy occur by reason of the failure of any of the said societies to act, or otherwise, such vacancy shall be filled by the board of award from the membership of the society so failing.

8. Should one or more of the four national societies go out of existence its representation on the board shall cease and determine, and future awards shall be made by the representatives of the remaining societies.

Convention of Kentucky and Southern Indiana Telephone Associations.

A joint convention of the Independent Telephone Associations of Kentucky and Southern Indiana was held in Louisville, Ky., on October 28 and 29. The joint meeting was called to order on the 28th by Mr. R. V. Bishop, of Cynthiana, Ky., the president of the Kentucky association. He introduced the Hon. H. L. Stone, city attorney of Louisville, who delivered an address of welcome to the delegates. The address was responded to by Mr. G. A. Keinle, president of the Southern Indiana Association.

Mr. S. P. Sheerin made some remarks as to the patent litigation being carried on by the national association, and asked the Kentucky association and the Southern Indiana association to contribute $1,000 and $2,000, respectively, to the cause. A committee was appointed to devise a plan for the assessment.

"Long Distance Toll Lines and Connections" was the subject of a paper read by Mr. H. K. Cole, of the Kentucky association. This paper was supplemented by a report from Mr. J. S. Brailey, Jr., who is superintending the construction of the Independent Long Distance system out of Louisville, on the work he is engaged in.

Mr. E. M. Coleman, secretary of the Louisville Home Telephone Company followed with a paper on the "Interstate Association."

The proceedings of the second day included the reading of a paper by Mr. James S. Brailey, Jr., on "Merging of Independent Telephone Plants." The point he made was that the companies should not consider their own service more than the service of their neighbors, and that they were mutually dependent upon one another. He prophesied that it would only be a question of a short time when the independent companies would be merged into district, state and national organizations.

Mr. A. L. Têtu, of Louisville, followed with a practical paper on "Operating and Governing a Telephone Plant." A paper on "Rates" was next read by D. L. Pendleton, of Winchester, Ky. Mr. Pendleton exhaustively discussed the subject.

"Our Relation Toward the National Asociation" was the title of a paper read by President G. A. Keinle, of the Southern Indiana Association.

After the reports of various committees were submitted, the election of officers for the two associations was taken up. Mr. D. L. Pendleton was elected president of the Kentucky Association, and H. K. Cole, of Lancaster, and James Maret, secretary and treasurer, respectively. The old officers of the Indiana Association were re-elected, as follows: G. A. Keinle, of Huntingburg, president; C. D. Knofel, of New Albany, vice-president; E. W. Pichardt, of Huntingburg, secretary, and T. M. Thorn, of Lamar, treasurer. The joint convention then adjourned. The social entertainment of the delegates included a smoker given by the Louisville Home Telephone Company and a banquet by James S. Clark, Jr., at Fountain Ferry Park, to which the delegates were conveyed in chartered cars. There were present about 150 delegates from Kentucky, Indiana and Ohio.

Electrical Features of the Michigan Lake Superior Power Company's Plant at Sault Ste. Marie, Michigan.

IN the issue of last week and that of September 27, 1902, were given descriptions which afford a good idea of the hydraulic equipment, dam and power house of the Michigan Lake Superior Power Company, at Sault Ste. Marie, Mich., the opening of which was recently celebrated. It is the purpose of the present article to go more fully into the electrical equipment of this mammoth water-power plant, which is second only to that at Niagara in size.

Although but a small portion of the electrical apparatus has been installed in this plant, the plans for it have all been outlined by Mr. W. Owen Thomas, the electrical engineer of the company, and include a number of interesting and original features, as certain problems have naturally come up in a plant of this size, containing, as it does, so many units, which have not been heretofore solved. The total capacity of the power house is 32,000 kw, in 80 units of 400 kw each. These units are small according to present standards, but four years ago, at the time the power house was planned, it is said that no turbine maker could be found who would undertake to make a horizontal-shaft turbine unit for such a low head as 20 feet, of larger capacity than this. As it is, there are four turbines on the same shaft for driving each electric generator. One-half of the output of the power house, as well as the space on the second floor of the power house, has been contracted for by the Union Carbide Company.

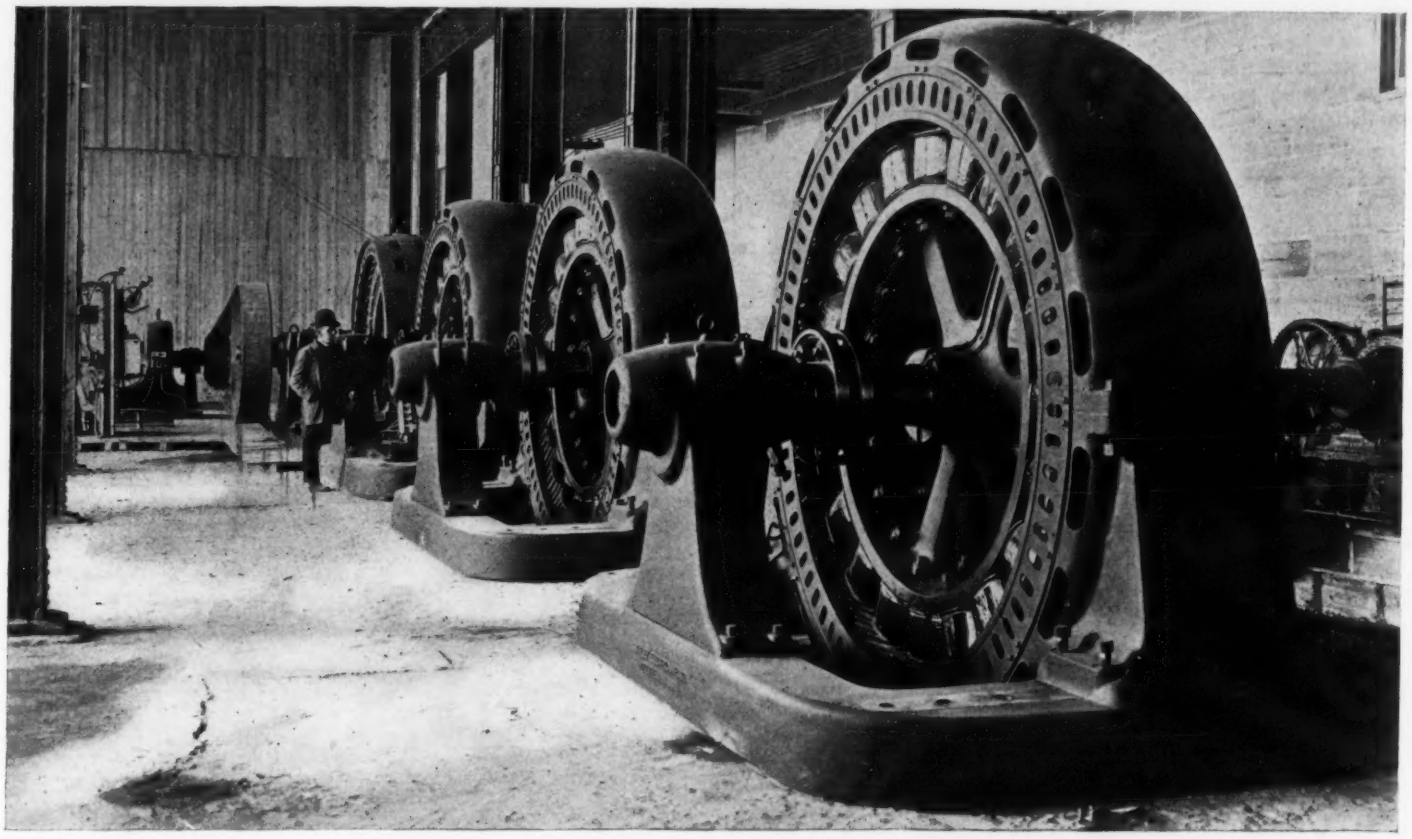


FIG. 1.—FOUR OF THE THREE-PHASE GENERATORS, SAULT STE. MARIE POWER PLANT.

The original contract for machinery was made with the Walker Company, and taken over by the Westinghouse Company, which will supply 42 single-phase, 60-cycle, 90-volt generators and two 220-volt direct-current generators, all of 400-kw. The carbide furnaces are to be placed on the second floor, directly above these generators in the power house itself. The balance of the output will be taken care of by the Michigan Lake Superior Power Company itself, and will consist of 33 Stanley, three-phase, 30-cycle, 2,400-volt generators and four direct-current, 600-volt, compound-wound generators for exciters. A 60-cycle, single-phase generator, previously belonging to the company, will also be used for local lighting. Each generator is connected to its turbine through a flexible coupling. As to civil and hydraulic engineering, the power house has been a comparative simple piece of work, following along established lines. In the matter of switchboard and electrical control, however, many points of special interest have come up. The plans have been worked out by Mr. Thomas, with the co-operation of Mr. C. C. Chesney, chief engineer, and Mr. E. O. Sessions, consulting engineer, of the Stanley Company.

It is easy to see, in the first place, that the control of the generators in one-half of this great power house, which is over a quarter of a mile long over-all, must be very complete to insure successful operation. The switchboard plans, which have been so far worked out, provide not only for the electrical control of the generator after it has started, but for starting and stopping it. The switchboard contemplated is in line with modern switchboard practice for large stations, in that none of the main circuits will be brought to the switchboard. All of the control will be by pilot circuits operating solenoid switches. The first plans contemplated, when the power house was started some four years ago, would have arranged all the generators to connect onto a continuous set of bus-bars extending the whole length of the board, each generator having a panel of the usual size with hand throw switches. This would have made the switchboard imposing in length, but would have also resulted in some rather startling results in the section of copper bus-bars required. It would also have the practical result of putting all the generators in the power house subject to interruption from a short-circuit anywhere on the switchboard. The switchboard now contemplated, as designed by Mr. Thomas, is in line with the modern idea of dividing the power house into sections, so that only a part of the generators feed into any one set of bus-bars. The effect of this is not only to cut down the amount of copper required for the bus-bars, but also to make it impossible to disable the whole station by short-circuit on the switchboard. The switchboard is to be divided into three sections with eleven generators on each section. Each section of the switchboard will be but 12 feet long, and the three sections will be placed to form three sides of a square, so that an attendant sitting in the middle can see the instruments on every section of the board. In order to make the board sufficiently compact, to make these small dimensions possible, each generator panel will be but six inches wide. The instruments will be Stanley make, redesigned so that they can be used as edgewise instruments. There will be two sets of bus-bars. Each feeder and each generator will be provided with a double-throw switch, so that it can be connected to either set of bus-bars.

There will be about half as many feeders as generators. The feeder

panels are to be located at the top of the generator panels, so that over each two generator panels there will be one feeder panel. The feeders themselves will connect to the bus-bars at the same points that the generators tap into the bus-bars. The bus-bars will, therefore, act simply as equalizers of the load between different generators and feeders, and only a small per cent. of the station output will flow over the bus-bars for any considerable distance. The three switchboard sections will have circuit-breaker switches for connecting them in parallel, if it is desired to deliver the load from one section on another. There will also be circuit-breaker switches for connecting together the two sets of bus-bars, and it is expected that ordinarily these switches will be closed in order to get the benefit of the copper in the two bus-bar sets. Half of the machines will then be operated on one set, and halt on the other. The switches will probably be oil-immersed, will be held closed by a current flowing in a solenoid, and will open automatically on overload or no voltage. Whenever current is broken in this solenoid, the switch will open so that in case anything goes wrong with the pilot circuits controlling the solenoids, the switches will open and a dangerous condition of affairs cannot be caused by having the switches closed, with no means of opening them from the switchboard. This is in a line with automatic block-signal practice, where any failure of electric circuits is on the side of safety, and it is an excellent idea to carry out in switchboard design. Beginning at the top of each panel of this novel switchboard, there will be a short panel devoted to one outgoing feeder, with ammeters of the edgewise type in each leg of the three-phase circuit. At one side of these three instrument dials is the pilot switch controlling the main-feeder switch. This control switch when thrown up connects its feeder to one set of bus-bars, and when thrown down, to the

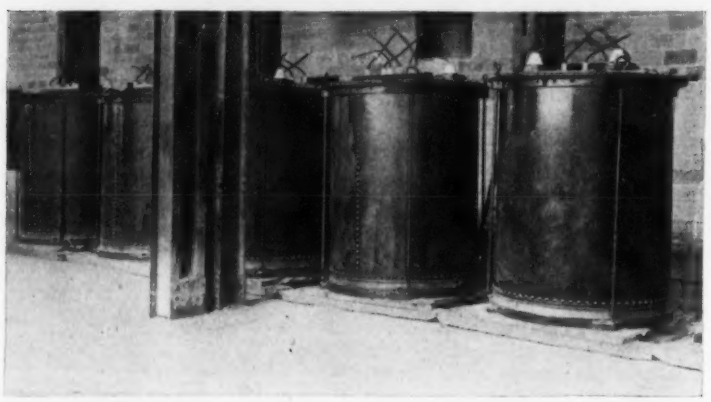


FIG. 2.—400-KW WATER-COOLED, OIL-INSULATED TRANSFORMERS.

other set. The solenoid switch, which is operated by this pilot circuit, will work on the same principle as the circuit breakers now made by the Stanley Company, in that it will be impossible to hold the circuit breaker closed upon a short-circuit. Energizing the solenoid will close the circuit breaker, but it will immediately open again in case there is a short-circuit. In case the pilot-circuit switch is closed in such a position as to close the main switch and circuit breaker, and the circuit breaker is open, a green lamp is lighted below the pilot switch on the board. This green lamp is lighted as long as the circuit breaker is open and the pilot switch closed; this, of course, being a condition of affairs which should not exist for any length of time. If the pilot switch is open, the circuit breaker will necessarily be open, and the green lamp will not be lighted.

Immediately below the feeder panel are two generator panels. Beginning at the top, each generator panel has an indicating wattmeter, at the side of which is the double-throw, pilot switch, controlling the solenoids of the main operating switch and circuit breaker, which is of the same type as that just described as used on the feeder. Next below this is an edgewise ammeter, in one leg of the generator circuit, at one side of which is a voltmeter switch. This voltmeter switch is for the purpose of connecting the generator to a voltmeter located elsewhere on the switchboard. There are two voltmeters on the board, one of which is permanently connected to the bus-bars, and the other one used only when a generator is being started up. The voltmeter switch will spring back to off position as soon as the attendant lets go of it. Next below the generator ammeter on the board is an edgewise ammeter in the field circuit of the generator. This ammeter has beside it a switch, by which the attendant at the board can regulate the speed of the water wheel driving the generator and can also start or stop the wheel. The principle of this control is very simple. A small direct-current motor is attached to the Lombard water-wheel governor so as to change the relative opening of the gates at a given tension of the governor balls. By rotating the motor in one direction, the gates are opened wider with the governor balls in a certain tension, and by rotating it in the other direction, the reverse action takes place. In starting up and increasing the speed, the attendant holds in the switch, which will cause this motor to revolve to open the gates wider. The motor will run to open the gates as long as the attendant holds the switch closed, but the switch will open as soon as the attendant lets go of it. The attendant can, therefore, bring the machine into exact synchronism without leaving the switchboard.

One very important feature of the way this switchboard is arranged is the facility with which the attendant can note any variation in the load carried by the several machines in operation. The dials of all the indicating wattmeters and ammeters being very close side by side, like instruments being in the same horizontal plane, and provided with scales of similar dimensions; it is easy to note the relative positions of the pointers on the same kind of instruments clear around the switchboard. To facilitate this, the pointers will be made broad and tapered to a point at one end for accurate reading of the scale. When the load is equal on all the generators, the wattmeter needles should show a continuous unbroken band around the length of the switchboard, and a variation on any instrument is easily noted by the break which it would cause in the line. The same thing will hold true with the ammeters in the field circuits of each generator. If the current in the field circuit of each generator is the same, the only thing which could cause a variation to the load taken by the different generators, would be a lack of sufficient gate opening on the turbines to hold a generator fully up to synchronism, or the reverse. In order to make the generator take its share of the load, the attendant would only have to hold his speed-regulating switch up so as to rotate the synchronizing motor for a few seconds, to change the governor adjustment and give a greater gate opening on the turbine driving that generator. The compactness and completeness of this switchboard commend themselves to every electrical engineer who has had to do with the switchboards of large power stations.

On each generator will be an emergency switch, as it is called, by which a man on the generator-room floor can open all the circuits leading to any generator in case of trouble. When this emergency switch is open, a red lamp is lighted on that generator panel. In addition to the red and green lamps on the generator and feeder panels for indicating the opening of the circuit breakers and emergency switches, all these signal circuits are connected to gongs, which ring whenever a lamp lights. The green lamps indicating the opening of the circuit breakers, of either the feeders or generator circuits will be accompanied by the ringing of an 18-inch gong, and the red lights indicating the opening of an emergency switch will be accompanied by the ringing of a 24-inch gong. All secondary circuits from potential transformers and from series transformers for operating indicating instruments will be grounded on one side as a safety precaution to prevent possible damage from the 2,400-volt generator current, in case of a cross between the primary and secondary coils of these small transformers.

The switches connecting the three different sections of the switchboard and also the switches for cross-connecting the two sets of bus-bars will be oil-immersed, solenoid control, circuit breakers similar to those used in the generator and feeder circuits. It will, therefore, be possible to isolate the short-circuit offering one any section or bus-bar of the switchboard, even though the entire switchboard is normally operated and connected in parallel.

For transmission to neighboring industries, 15,000 volts have been adopted as the standard, and the transmission lines will be run as far as possible along the company's canal. The transmission lines will be put on 60-foot Idaho white cedar poles, 90 feet apart, and mounted on Locke No. 3 insulators. The step-up transformers will be Stanley 400-kw, water-cooled and oil-insulated. In addition to the direct-current machines mentioned there are to be some Stanley synchronous motor-generator exciter sets. The direct generators driven therby will be in parallel with a Chloride storage battery, consisting of 144 cells in lead-lined tanks. This battery is rated to maintain a discharge of 50 kw for eight hours, 70 kw for five hours, and 100 kw for three hours.

The Measurement of Bodies Smaller Than Atoms.

BY S. N. TAYLOR, PH. D.,

THE object of this article is to show as simply and briefly as may be how the masses and velocities of the particles which constitute cathode rays are measured. References will be made to original papers for any who may wish a fuller knowledge of the subject.

It is now generally admitted that cathode rays are made up of minute particles called ions, thrown with great velocity from the cathode terminal of the vacuum tube. If the masses of these particles can be measured, and if the velocity with which they move can be determined, the truth of the hypothesis is made manifest. Such measurements have been made by Professor J. J. Thomson and others, with results which show that the ions are approximately only $\frac{1}{1000}$ as large as the hydrogen atom, and that they move with a velocity approaching that of light.

The first investigations of the masses of atoms were made by Loschmidt, Stoney and Lord Kelvin, some 30 years ago. Their results show that in a cubic centimeter of gas at standard temperature and pressure there are some twenty million million million (2×10^{18}) molecules. This has been verified many times since then.

One way of determining the masses of atoms is by the electrolytic method. The principle of this is as follows:

From Faraday's laws it has been deduced that when a current of electricity passes through a liquid, the electricity transmitted is carried through by the moving atoms, or ions of the substance, each one carrying an equal charge. Hence the number of atoms and the total weight of the atoms set free will be proportional to the quantity of electricity transmitted. In the electrolysis of water, for example, the weight of hydrogen set free by the transmission of one c. g. s. unit of electricity is always found to be $\frac{1}{10}$ milligramme in round numbers, and this is called the electrochemical equivalent of hydrogen. If, then, it requires n atoms of hydrogen to convey one unit of electricity through the liquid, and if q denotes the quantity of electricity on each atom of hydrogen, then $\frac{1}{q}$ must equal n, the number of atoms liberated by one unit of electricity. But this is the electrochemical equivalent of hydrogen, and in round numbers has been found to weight $\frac{1}{10}$ milligramme. In other words, one atom of hydrogen weighs $\frac{1}{10n}$, or $\frac{q}{10}$ milligramme. So that if we can find n, the number of atoms set free, or if we can find q, the quantity of electricity on each atom, in either case we can determine the weight of the individual atom of hydrogen.

The same method of reasoning may be applied to the minute particles in cathode rays, but the application, experimentally, is far more complicated in the latter case than in case of the liquid.

Cathode rays, as they stream through the vacuum tube, are now conceded to consist of minute particles of matter, negatively electrified, proceeding with great velocity from the cathode or negative terminal. That these particles or ions are not atoms will be seen from their masses, which are to be determined.

Sir George Stokes has proven that a ray of electrified particles can be deflected from its path by the action of a neighboring magnet. When the magnetic lines of force are perpendicular to the velocity of the particles, the force acting upon the particles is expressed by $\mathfrak{H} q v$, where $\mathfrak{H}$ denotes the strength of the magnet field, q the charge upon each particle, and v the velocity. Stokes also found that the path of the ray would be bent so as to form the arc of a circle, the radius of which would be expressed by the formula

$$(1) \quad r = \frac{mv}{q\mathfrak{H}}, \text{ or } v = \frac{qr\mathfrak{H}}{m}$$

where r denotes the radius of the circle and m denotes the mass of each particle.

Then let this method be applied to the cathode ray, and let the ray pass between the poles of a magnet (†). If, then, N denotes the number of particles which pass a point in a given time, and if Q denotes the quantity of electricity carried by them, then

$$(2) \quad Q = Nq.$$

These particles strike with great velocity upon any interposed object and raise its temperature, thereby doing work. The work done can be measured by noting the rise in temperature produced, if we know the mass and specific heat of the object whose temperature is raised. But the work done is also expressed by the formula for kinetic energy, namely,

$$(3) \quad W = \tfrac{1}{2}Mv^2.$$

Hence, from equations (2) and (3), since $M = Nm$,

$$\frac{Nmv^2}{2Nq} = \frac{W}{Q} \quad \text{and from (1)}$$

$$v^2 = \left(\frac{qr\mathfrak{H}}{m}\right)^2 \quad \text{whence}$$

$$(4) \quad \frac{m}{q} = \frac{Qr^2\mathfrak{H}^2}{2W}$$

So that to determine the ratio of the mass of the ion or particle to the charge upon it by this method, we must find how to measure four different quantities. Q can be measured by letting the charged particles fall upon the terminal of a quadrant electrometer; W is obtained from the rise in temperature produced by the particles, as indicated by a thermopile placed in their path; is obtained by knowing the current passing through the coils of the electromagnet which produces the magnetic field; and r is measured by optical methods.

There is another way of determining $\frac{m}{q}$, namely by static method. If the cathode rays are made up of particles of matter charged with negative electricity, they should be attracted or repelled in the presence of other charged bodies. This is found to be the case, and the fact is made use of for determining the ratio $\frac{m}{q}$.

Suppose a cathode ray be made to pass between two metal plates, A and B, placed parallel to its path. As long as the plates are uncharged, the ray continues in a straight line, and the point where it strikes the end of the tube may be noted on a scale placed in the tube, but if A is then charged positively and B negatively, the particles of the ray will be attracted by A and repelled by B, and the ray will be deflected from its former straight line, and the amount of deflection can be noted on the scale at the end of the tube. Let F denote the strength of field produced by the charges on A and B, and let q denote the charge on each particle of the ray, then Fq will equal the displacing force acting on each particle. Let l denote the distance passed over in the field F during the time t. Also let v denote the velocity of the particles parallel to A and B, due to the cathode; let v^1 denote the final velocity of the particles perpendicular to A and B, due to the force Fq, and a denote the acceleration produced by force Fq perpendicular to A and B. Then $v^1 = at$. But

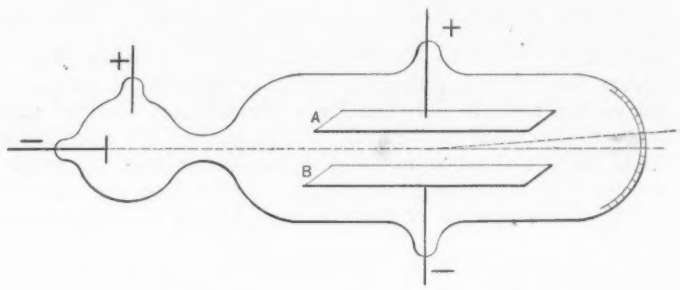


FIG. I.—DETERMINATION BY STATIC METHOD.

$$a = \frac{Fq}{m} \text{ and } t = \frac{l}{v}$$

Therefore $$v^1 = \frac{Fq}{m} \times \frac{l}{v}$$

But the angle θ, which the deflected ray makes with the velocity v, is $\frac{v^1}{v}$ hence

$$(5) \quad \theta = \frac{Fq}{m} \times \frac{l}{v^2}$$

If in the place of the plates A and B charged statically, electromagnets, of strength H, had been used, then since, according to Stokes's formula, the displacing force is Hev, Φ the angle of displacement produced by the magnetic field would have been,

$$(6) \quad \phi = \frac{\mathfrak{H}qv}{m} \times \frac{l}{v^2}, \text{ or } \frac{m}{q} = \frac{\mathfrak{H}}{\phi} \times \frac{l}{v}$$

† Cathode Rays: J. J. Thomson; *Phil. Mag.*, Oct., 1897.

Combining equations (5) and (6),

$$(7)\quad v = \frac{\varphi F}{\Theta \mathfrak{H}}$$

Substituting this value of v in equation (6)

$$(8)\quad \frac{m}{q} = \frac{\mathfrak{H}^2 \Theta\, l}{\varphi^2 F}.$$

If, however, the static method and the magnetic method are both used at the same time, one in opposition to the other, and if the strength of the magnetic field is adjusted so that the deflection which it produces exactly equals that produced by the static field, then the length l of the field being the same in both cases, Φ will be equal to Θ, and equations (7) and (8) become, respectively,

$$(9)\quad v = \frac{F}{\mathfrak{H}} \quad \text{and}$$

$$(10)\quad \frac{m}{q} = \frac{\mathfrak{H}^2 l}{F \varphi}$$

Thus, if both static and magnetic methods are used, all that is necessary to determine v, the velocity of the particles, is to know F, the strength of the static field, and $\mathfrak{H}$ that of the magnetic. To determine the ratio $\frac{m}{q}$, we need to know both F and $\mathfrak{H}$, and also l, the length of the field, and Θ the angle of deflection produced when the static force alone is acting, all of which can be accurately determined, as has been shown.

Now cathode experiments of this kind, made with different gases, though consistant with themselves, do not agree with the results for similar elements determined by the electrolysis of liquids. In cathode rays the velocities differ for different gases, and also differ with different conditions of the same gas. The ratio $\frac{m}{q}$ of the mass of the cathode particle to the charge upon it is the same for all gases, whatever the materials, though in the electrolysis of liquids the value of the ratio is different for every different kind of atom. Moreover, the value of the ratio, as determined for all gases by cathode rays, is about a thousand times smaller than the smallest value obtained by electrolysis; that is, smaller than the value obtained by the electrolysis of water, which gives us the weight of the hydrogen atom.

The question arises, is the smallness of this ratio due to the fact that the mass of the cation is a thousand times smaller than the hydrogen atom, or is the charge upon the cation a thousand times greater? Since the mass of the hydrogen atom is known, the crucial test would be to measure independently either the mass of the cathode particle, or the charge upon it. This does not seem to be possible, however, in the case of the cathode ray, but the ionization of gases at low pressure can be produced in many ways. For example, it can be done by means of Röntgen rays (J. J. Thomson, *Phil. Mag.*, May, 1899); by means of a heated wire (E. Rutherford, *Phys. Rev.*, December, 1901); by a carbon filament raised to incandescence (Elster and Geitel, *Wied. Ann.*, Vol. 38), or by the method of ultra-violet light (J. J. Thomson, *Phil. Mag.*, December, 1899). So far as similar determinations can be made by these various methods, applied to gases, they seem to give essentially the same results. The velocities obtained by the different methods are commensurate with themselves, though in all cases vastly greater than the velocities obtained for liquids. The value of $\frac{m}{q}$, however, is the same for all gases by whatever method determined. Therefore, scientists feel justified in assuming that the mass of the particle is the same, and that the quantity of electricity upon it is the same whether the gas is ionized by means of cathode rays or by one of the other methods.

The simplest way by which the charge q upon the ion of gas has been measured is, perhaps, the process in which the gas is ionized by means of ultra-violet light. In this the ratio $\frac{m}{q}$ is first determined by methods which may be omitted here. The value of the ratio as thus obtained is found to be essentially the same as the value obtained by the cathode ray methods, and there is every reason for believing also that the values of both m and q are identical in both processes. If this is true, then the value of the charge q obtained by this method will be the charge upon each particle in the cathode ray, and the value of the mass of the particle will be known in both cases.

The apparatus used for determining q by the ultra-violet light method, is as follows:

A zinc plate, AB, Fig. 2, is suspended in an air-tight vessel, RS, and carefully insulated from it. The vessel has a quartz bottom, CD, through which the ultra-violet light can be transmitted, and the bottom of the vessel is covered with water, which is connected electrically with the earth. Also by means of a tube, T, at one side the vessel is connected to an apparatus by which the gas in the vessel can be exhausted, or the pressure of the gas can be quickly diminished a known amount at pleasure. The plate AB is connected with one pair of the quadrants of an electrometer, and the other pair of quadrants is connected with the earth. The gas in the vessel having been exhausted the desired amount, AB is charged negatively, the ultra-violet light is then turned on, and the deflection of the electrometer is noted. Let b denote the distance between the plate AB and the surface of the water, and let KD denote the initial potential difference between them, as indicated by the electrometer, then $\frac{KD}{b}$ will be the potential gradient between the two surfaces.

Under the action of the ultra-violet light the gas becomes ionized, and negative electricity is conveyed from AB to the water by means of the ions, but the quantity of electricity transmitted between unit surfaces will be proportional to the number of ions between them, to the charge upon each ion, and to the velocity with which the particles are driven by means of the electric force, or, in other words, it will be expressed by $n^1 q u$, where n^1 denotes the number of ions in each cubic centimeter of the gas, q denotes the charge upon each

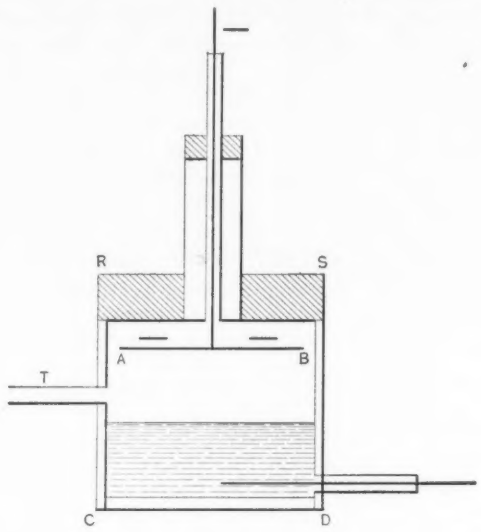


FIG. 2.—DETERMINATION BY ULTRA-VIOLET LIGHT METHOD.

ion, and u is the velocity with which they are moved by the electric force.

Now the velocity with which ions move in a field of unit gradient has been determined. (E. Rutherford, *Proc. Camb. Phil. Soc.*, Vol. 19.) If the unit gradient in this case is denoted by U_0, then U, the velocity, will be $U_0 \frac{KD}{b}$, and the quantity of electricity lost per second by the plate will be

$$A n^1 q U_0 \frac{KD}{b}$$

where A denotes the area of the negative plate.

Also, if the fall in potential, as indicated by the quadrant electrometer, is Kd units per second, then the quantity of electricity lost by the plate AB each second will be

$$K d C$$

where c is the electrical capacity of the electrometer system. Therefore

$$A n^1 q U_0 \frac{KD}{f} = K d C \quad \text{or}$$

$$(11)\quad q = \frac{b C d}{N^1 U_0 A D}$$

All of these are known quantities except q and n^1. In order, then, to determine q by this method, it is necessary to count the number of ions in each cubic centimeter of gas. This is a difficult problem, and great ingenuity and skill have been displayed in its solution.

Mr. C. T. R. Wilson (*Phil. Trans.*, 1897) has shown that in a vessel containing dust-free air saturated with moisture, ions act as particles of dust would do, in assisting condensation; that if the air containing these ions is suddenly cooled by expansion, each ion becomes a nucleus around which a minute drop of water is formed.

Moreover, Sir Geo. Stokes has proven that the velocity with which a drop of water falls through a gas is

$$(12) \quad V = \frac{2 g R}{M u}$$

where g is the acceleration of gravitation, R is the radius of the falling drop, and M is the coefficient of viscosity of the gas through which the drop falls. In other words, since g and M are both known, if V, the velocity of the falling drop, can be measured, R the radius of the drop can be calculated. Making use of this fact and the previous one, the following method is adopted for counting the number of ions per cubic centimeter of the rarified gas in question.

The gas in the vessel RS is carefully freed from all particles of dust, and, since there is water in the vessel, the rarefied gas is saturated with moisture. If, then, the gas is quickly expanded a known amount, its temperature will fall a known number of degrees. The drop in temperature would naturally cause condensation of moisture if the gas contained particles of dust, but almost no condensation without them. Mr. Wilson has shown that in the absence of these the moisture will condense around the negative ions, each ion being the nucleus of a drop of water.

The requisite ions are produced by the ultra-violet light, hence a cloud of moisture becomes visible and is seen to settle gradually, due to the action of gravitation.

The total mass of moisture deposited upon the ions becomes known, from the known expansion of the gas. The size of each drop in the cloud becomes known from the observed velocity with which the cloud falls, and from Stokes's formula; also the mass of each drop of water is known from its size and density. Hence, knowing the mass of water in the cloud and the space in which it is formed, we know the mass of water deposited per cubic centimeter, and, knowing the size of each drop, we know the number of drops per cubic centimeter, and as each drop contains a nucleus or ion, we known n^1, the number of ions in each cubic centimeter of gas.

The value of n^1 inserted in equation (11) gives us the value of q, the quantity of electricity on each ion, as desired. Also the value of m, the mass of each ion, or negative particle, becomes known.

The results obtained from these and other similar experiments show that the negative ion of gases carries the same quantity of electricity as the hydrogen atom does in the electrolysis of liquids; while the mass of the negative ion in gases is only about one- thousandth as large as the smallest known atom, a value which seems to be identical for all gases.

The velocities of these minute particles in some cases are found to approach the velocity of light. The minuteness of their masses and the magnitude of their velocities has led J. J. Thomson to call them "corpuscles," recalling the former corpuscular theory of light.

These results have a very important bearing upon the generally accepted conception of the constitution of matter. It would tend to indicate that the various forms of matter instead of being composed of many different primary substances called elements, consist of but one fundamental substance, from which all the so-called elements are formed.

The different kinds of atoms seem to be only different groups of these corpuscles, differing only in the number of corpuscles contained, and possibly in the structure and manner in which they are united.

The negative charge of electricity always seems to be carried by these minute corpuscles, while the positive remains with the larger atom.

It would seem that when an atom contains its normal number of corpuscles, it is neutral; that if one of its corpuscles is removed from it, the separated corpuscle carries a negative charge, while the atom from which it was removed is positive. Thus the atom is said to be charged positively.

The hypotheses suggested by the above data seem to explain many electrical and optical phenomena hitherto unaccounted for.

How far the facts determined by these and many similar investigations will go toward explaining the nature of electricity, the constitution of matter, or what is gravitation, only the future can decide, but they are suggestive of many lines of investigation which cannot fail to be fruitful in the future.

Terminology of Primary and Storage Battery Electrodes.

BY A. L. MARSH.

A GREAT deal has been written concerning the correct use of the terms positive and negative as applied to the electrodes of primary and secondary cells. The usage in the case of the primary cell is rather uniform, but with the secondary or storage cell, it is greatly confused. Some of this confusion has undoubtedly arisen from our imperfect understanding of the actions occurring in the cell, but probably more is due to the different points of view from which the matter is considered.

For example; it has been suggested that perhaps some consider the question from the standpoint of the charging cell. Another suggestion is that a certain terminology may be more convenient for commercial use than another. In regard to the latter point, it is more convenient because it has become a custom to use it in certain places. In the United States the peroxide electrode is generally called the positive while in some other countries it is called the negative, and no doubt each locality finds its terminology the most convenient.

A suggestion has been made to the effect that manufacturers may be justified in calling the peroxide plate positive because the pole is positive and since the layman may not be aware of the change in sign from one end of the plate to the other, this terminology is simpler and less apt to lead to mistakes. The scientific man, it was said, should not use the terms in the same loose and incorrect way.

This way of treating the matter would not tend to avoid the existing confusion, but would rather increase it. Whatever terms are eventually adopted, they should be used in the same sense by both the manufacturers and the men of science.

A number of terms have been from time to time suggested as a possible solution of the difficulty. Daniell suggested the terms zincode and platinode to designate the plates of a cell. These terms, while being definite in one case, do not seem appropriate for use in all cells.

Peroxide plate and spongy lead plate are open to the same objection.

Positive pole electrode and negative pole electrode seem useless expansions of the simpler terms.

Anode and cathode introduced by Faraday, are terms better suited to electrolytic decomposition work than to the requirements of the voltaic cell for the reason that we think of a current as entering a cell when it comes from an outside source while the current of a primary cell is generated within itself. However, these terms are well defined and ought not lead to confusion.

Gladstone and Tribe in "The Chemistry of Secondary Batteries" thus define the terms: "The two plates of a Planté or Faure battery consist essentially of lead peroxide as the negative element, and metallic lead in a spongy condition as the positive."

The International Cyclopedia contains the following: "Lead is the metal most commonly used in accumulators, the positive plate having a coating of lead peroxide, PbO_2 and the negative plate a surface of spongy lead."

Treadwell uses the term positive for the peroxide plate, but the reason which he gives, quoted from the London *Electrician*, serves better for a description of the plates.

Sir David Solomons, in his work on "Accumulators," makes this statement: "It has become a practice among makers of secondary cells to call the true positive, negative, plates, and *vice versa;* therefore not to cause confusion, the manufacturers' designations will be adhered to throughout."

Benjamin, in his book, "The Voltaic Cell," refers to the confusion and then goes on to define the terms. He thinks that the main confusion arises from the fact that writers fail to state whether they regard one electrode as positive to the other or the reverse, with reference to the direction of the current outside of the cell or to the direction of the current through the electrolyte inside of the cell, so in the case of accumulators, a new difficulty presents itself when the terms positive and negative are used without any statement as to whether they refer to the condition of the cell when it is being charged or when it is yielding its own current. He uses the terms from the standpoint of the charging cell and calls the peroxide plate, positive and the spongy lead plate, the negative, but in his description of primary cells, he calls carbon the negative, and zinc, the positive.

In primary cells the zinc element is quite universally termed the positive electrode. Zinc has always been considered an electro-positive metal, that is, electro-positive relative to the other metals commonly used in cells. It is generally the principle source of energy. In the lead cell, a large part of the electromotive force is due to the peroxide electrode and it may be for this reason that the peroxide came to be called positive, though it is more probable that this has arisen from the fact that polarity of the terminal is positive and the use of the term has been extended to the entire electrode.

Primary and secondary cell terminology should certainly agree, for the cells are the same in principle; the only difference being that the secondary cell, after being discharged, can be brought back to approximately the same condition as before discharge, by passing an electric current through it in the reverse direction.

Let us now consider the modern theory of the solution pressure of metals due to Nernst, and see what light it can throw on this matter. The following brief statement of the theory is taken from Jones' Outlines of Electrochemistry":

P = solution tension of the metal.

p = osmotic pressure of the metallic ions in the electrolyte.

"Let at first $P > p$; at the moment of contact (metal with electrolyte) a number of positively charged metallic ions, driven by this larger pressure, will pass into solution. Since by the latter a certain amount of positive electricity is carried from the metal into the solution, the liquid receives a positive charge, which arranges itself in the form of positive ions contained in the solution, on the surface of the metal. At the same time there is, of course, a corresponding amount of negative electricity set free in the metal, which also passes to the surface of the metal. We recognize at once, that at the surface of contact of metal and electrolyte the two kinds of electricity must accumulate in the form of a double layer, whose existence, as is well known, was made probable some time ago by Von Helmholtz, in an entirely different way." . . . "If now, we inquire which metals have high and which low solution-tensions, we will find that magnesium, zinc, aluminum, cadmium, iron, cobalt, nickel, and the like, are always negative when immersed in solutions of their own salts. This means that the solution-tension of the metal is always greater than the osmotic pressure of the metal ion, in any solution of their salts which can be prepared. If, on the other hand, we take gold, silver, mercury, copper, etc., we usually find the metal positive when immersed in a solution of its salt."

This brings out the fact that metals such as zinc, lead, etc., are negatively charged when dipped in a solution of their salts and metals like copper receive a positive charge, the layers of solution lying nearest the plates receive a charge opposite in sign to that of the plates.

The terminology selected should be justified not only by our conceptions of chemical generators, but also by the other well-known devices for the generation of electricity.

When glass is rubbed with silk, there is an electric separation on the two substances. Glass is charged positively, and silk negatively. In the series which shows the electrification possessed by a substance when rubbed with others, glass is placed at the positive end relative to silk. In the electrochemical series, zinc is placed at the positive end relative to copper, although zinc is charged negatively relative to copper when dipped in a solution.

If a bar of bismuth and one of antimony are brought into contact and their junction heated, a current of electricity will flow from the bismuth, through the external circuit, to the antimony. In the thermo-electric series, bismuth is placed at the positive end and antimony at the negative. It would, therefore, seem that with the electrochemical series we do not follow out the analogies of the other series.

Sodium bicarbonate, placed in a red-hot capsule, decomposes with production of carbonic acid anhydride (CO_2). The capsule is electrified positively, while the acid carries with it negative electricity.

On heating a platinum plate containing silver oxalate this salt decomposes rapidly, leaving behind silver which becomes positively electrified.

Palmieri has found that with bisulphide of carbon, benzine, petroleum, and the vegetable oils, a flame from these bodies shows positive electricity when the capsule in which the burning occurs is connected to the earth, or that the capsule shows negative electricity when connected to a condenser if there is placed in the flame a plate or wire of platinum in communication with the earth.

It is, therefore, plain that whenever a substance as a metal or oil, is burned, or oxidized in a battery, the substance and the conducting plate in contact with it, receives a negative charge; and whenever a substance is reduced by heat or in a battery, the conducting plate in contact with it, is positively electrified. By applying this rule we can determine the sign of the charge in any case. In a lead storage cell, the spongy lead is oxidized, therefore we should expect that plate to be charged with negative electricity. The peroxide of lead is reduced so that plate will be positive.

Since in the voltaic cell the zinc is negative and the copper positive, the current passing from copper to zinc in the external circuit (in the generally accepted terms) it is the simplest to regard the zinc as the negative electrode. Why a pole is positive and the plate a few inches farther down is called negative, is a complication which is not easily understood, and for which there seems to be no need.

We are in need of terms which mean the same to all and which express the truth without involving too much of the complex theories that are apt to be changeable and at variance with each other.

In the lead storage cell the positive electricity comes from the peroxide plate into the external circuit, that is, the peroxide plate is charged positively with respect to the electrolyte and to the spongy lead. Therefore, why not call the lead peroxide the positive electrode?—a thing that is generally done in this country.

Granting this, we should be consistent and call the copper or the carbon of the primary cell, the positive electrode. This seems to me to be the simplest solution of the difficulty and one, too, which is perfectly correct from the viewpoint taken.

There is another way of definitely designating the electrodes of a cell—one which does not involve the terms positive and negative. This is by use of the terms anode and cathode as suggested by Faraday. These terms are well defined and are applicable to all cases.

But it seems to me to be unnecessary to abandon the use of positive and negative. They are most convenient for commercial use because they correspond to the terms used in the other forms of electric generators, and if they are correctly used there should be no objection to using them even if they do not describe the condition of the ions corresponding to the same metal in the form of an electrode.

I think that the principal difficulty lies in this; in the theory of electrolytic action it is assumed that the ions are the carriers of electricity and that oxygen and chlorine ions carry a negative charge while the metals and hydrogen, a positive charge. Therefore, it is said, that oxygen is electronegative and the metals, electropositive. Hence they say zinc or spongy lead is the positive electrode or plate and carbon or peroxide of lead is the negative plate.

It is unnecessary and decidedly more complicated to name the electrodes according to the theories of the method by which the electrodes receive their charges than to name them with respect to the results produced on them; and this latter method has its analogies in the other forms of generators of electricity as before mentioned; is less abstract and would not change with any change in the theory of electrolytic action.

Growth by Electricity.

Dr. Maurice Springer read an interesting paper at the Academy of Medicine, in Paris, on animal growth, specifying four elements of nutrition having most effect in inducing organic development—namely, lecithin, potash, oxides and water. The doctor also pointed out that electricity is a powerful agent in the development of growth. By applying a Faraday current to certain muscles and joints of children, both growth and increase of weight have been obtained.

The Use and Advantages of the Alternating Current for Land Telegraphy—II.

BY EDWIN F. NORTHRUP.

THE question, however, arises if anything can be done to the lines to increase the limits of duplex working. This limit will be increased in proportion as the ratio of the received current to the current sent can be increased. The ratio may be increased in two ways: First, the line can be made of lower resistance and its leakage diminished by better insulation; second, by increasing the self-induction of the line, the ratio of the received current to the current sent is increased very much. Let us examine the influence of making each of these changes.

Let I_l be the current received at a point of the line distant from the beginning $X = l$. Let I_0 be the current entering the line at its beginning, that is, the point where $X = O$. Then we have to investigate the various ways of increasing the value of the ratio $W = \frac{I_l}{I_o}$

Put equation (10) in the form

$$I = \frac{1}{a - j\beta}\left\{A\,\varepsilon^{-aX}(\cos\beta X + j\sin\beta X) - B\,\varepsilon^{aX}(\cos\beta X - j\sin\beta X)\right\} \quad (21)$$

The current is here seen to consist of two components, one, a wave, the amplitude of which decreases in passing from the dynamo down the line, and, a reflected wave. First assume the line to be infinitely long. Then when $X =$ infinity, $I = O$, and as $\varepsilon^{-aX} = O$ we see that $B = O$. Hence, for a line of infinite length the reflected wave does not exist, and

$$I = \frac{A\,\varepsilon^{-aX}}{a - j\beta}(\cos\beta X + j\sin\beta X) \quad (22)$$

If the value of the current is known at the dynamo end of the line, or where $X = O$, then this value is, $I_o = \frac{A}{a - j\beta}$, and hence

$$A = I_0(a - j\beta)$$

Putting this value of A in equation (22) gives

$$I = I_0\,\varepsilon^{-aX}(\cos BX + j\sin BX) \quad (23)$$

The phase of I is $\tan\omega = \frac{\sin\beta X}{\cos\beta X} = \tan\beta X$ or $\omega = \beta X$.

Thus the phase angle increases uniformly with increase of distance down the line.

The absolute value of I is

$$I = I_0\,\varepsilon^{-aX}\sqrt{\cos^2\beta X + \sin^2\beta X} = I_0\,\varepsilon^{-aX}$$

The ratio of the current at any point, l, of a line of infinite length to the current, at the generator end of the line, is

$$W = \frac{I_l}{I_0} = \varepsilon^{-al} \quad (24)$$

This equation, which is only approximate for lines of finite length will serve to show, nevertheless, how the ratio of the current received to the current sent is affected by varying the constants of the line. When written out in full (see Eq. 7. page 741, November 8).

$$W = \varepsilon^{-l}\sqrt{\tfrac{1}{2}\left\{\sqrt{(r^2 + x^2)(g^2 + b^2c^2)} + (gr - xbc)\right\}} \quad (25)$$

We will assume, first, that $g = o$, that is, that the insulation of the line is perfect. Putting, then, $g = o$ gives

$$W = \varepsilon^{-l}\sqrt{\frac{bc}{2}}\sqrt{\sqrt{(r^2 + x^2)} - x} \quad (26)$$

or expanding

$$W = \varepsilon^{-l}\sqrt{\pi N C}\sqrt{\sqrt{(r^2 + 4\pi^2 N^2 L^2)} - 2\pi N L} \quad (27)$$

Assume for the moment that L, the self-induction of the line is also zero, then,

$$W^1 = \frac{1}{\varepsilon^{l}\sqrt{\pi N C r}}$$

Thus the ratio of the current received to the current sent will increase as N, C, or r, decreases. As will appear later, the number of signals that can be sent per second will be proportional to N, the frequency, so it would not be advisable to reduce N. C, the capacity of the line, cannot be reduced any appreciable amount. r, the resistance, can be reduced at the expense of using larger wire.

Let, $W^1 = \varepsilon^{-l}\sqrt{\pi N C \times 2.67}$

be the ratio of the currents when No. 9 copper wire of 2.67 ohms per kilometer is used for the line.

Let, $W_1 = \varepsilon^{-l}\sqrt{\pi N C \times 1.24}$

be the ratio when No. 5 copper wire of 1.24 ohms per kilometer is used. Then, if $N = 100$ and $C = .0062 \times 10^{-6}$ and l is taken 1,212 kilometers (which, if g and L had not been neglected, would be one-half wave length).

$$W^1 = \frac{1}{\varepsilon^{2.76}} = \frac{1}{15.7} = .064, \text{ nearly}$$

and $$W_1 = \frac{1}{\varepsilon^{1.88}} = \frac{1}{6.5} = .153, \text{ nearly.}$$

Thus in the above particular case by making the line of about half the resistance the ratio of the current received to the current sent is more than doubled.

To show more clearly the variations which can be made in the ratio of the current received, at any point of an infinite line, to the current entering the line, I have plotted two curves, V and VI (Figs.

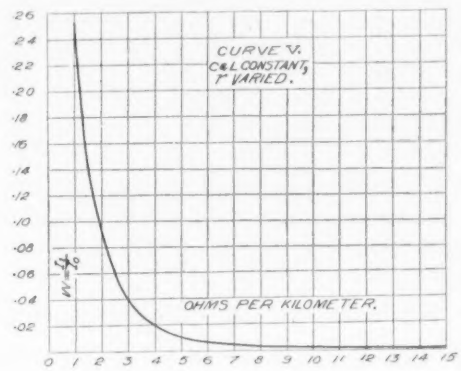


FIG. 7.—VARIATIONS IN RATIO OF CURRENT.

7 and 8). Curve V gives W (see equation 26) as a function of r, the resistance, all the other quantities in equation 26 remaining constant, and Curve VI gives W as a function of L, the self-induction, all the other quantities being considered constant. For plotting both

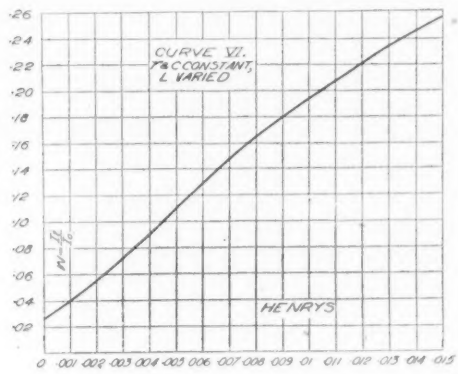


FIG. 8.—VARIATIONS IN RATIO OF CURRENT.

curves, l, the distance from the end of the line, is taken to be 1,600 kilometers, or nearly 1,000 miles. The

$$\sqrt{\frac{bc}{2}} = \sqrt{\frac{3.89}{2} \times 10^{-6}}$$

For Curve V the value assigned to x is 1.13, where $x = 2\pi N L$, and r is made to vary from 1 ohm to 15 ohms per kilometer. Then

$$W = \varepsilon^{-2.28}\left\{\sqrt{1.28 + r^2} - 1.13\right\}^{\frac{1}{2}}$$

The curve shows how rapidly the ratio of the currents decreases as the resistance increases. It is seen that under the assumed con-

ditions, at about 2 ohms per kilometer the value of the ratio is greatly effected by small changes in the resistance.

In order that $\frac{1}{10}$th of the current, a quantity needed for duplexing, may reach 1,000 miles, the line of infinite length would have to have a resistance as low as 1.9 ohms per kilometer, and be perfectly insulated.

Curve VI is plotted by means of the formula

$$W = \epsilon^{-2.23} \left\{ \sqrt{7.13 + 394761\, L^2} - 628\, L \right\}^{\frac{1}{2}}$$

where the value of $l\sqrt{\frac{bc}{2}}$ is the same as for curve V and $r = 2.67$ ohms, the resistance of No. 9 copper wire per kilometer.

L, the self-induction, is varied from 0 to .015 henry per kilometer. The value of W is seen from this curve to increase almost uniformly with increase in the self-induction of the line. To increase the self-induction of the line beyond that which is natural to it, namely, about .0018 henry per kilometer, it would be necessary to insert at intervals in the line impedance coils. If these coils are made without iron the ohmic resistance of the line would be considerably increased by their use. If they contain iron there will still be energy losses due to hysteresis, etc. Since self-induction increases the current ratio and ohmic resistance decreases it, it becomes a matter of calculation for any particular case to determine what the gain will be, if any, by inserting impedance coils in the line which would have, necessarily, resistance as well as self-induction.

It would be interesting to make some calculations here on this subject, but the limits of the present article will not allow us to do so.

Equation 24, which *accurately* expresses the ratio of the current received at any point of a line of *infinite* length to the entering current, is only approximate for a line of finite length and grounded at the end. If, however, the line is very long, say over one wave length, then $W = \epsilon^{-al}$ still expresses the ratio with considerable accuracy, if l is taken as a point in the line not more than about three-quarters the length of the line from the generator end. Thus referring to the line for which curves I to IV were plotted, $W = \frac{Il}{Io} = \epsilon^{-al}$ gives for $l = 1{,}261$ kilometers the value, $Il = 7.11$ instead of the correct value, 7.16, and for $l = 1{,}940$ kilometers, $Il = 1.591$ instead of the correct value of 1.475. But if $l = 2{,}425$ kilometers, the total length of the line, then $Il = .5284$ instead of 1.0058, the correct value. Thus, since $.5284 \times 2 = 1.0568$, which is very nearly equal to 1.058, if we wish to find the ratio of the current received at the grounded end of a long line to the current which enters the line, we can do so with a very small error by assuming that

$$W = \frac{Ig}{Io} = 2\, \epsilon^{-al}$$

where Ig equals the current at the grounded end of the line and Io equals the current at the dynamo end.

Again, if the distances are measured positive from the grounded end towards the dynamo, then, if X is the distance, it can be shown that

$$W = \frac{Ig}{IX} = \frac{2}{(\epsilon^{2aX} + \epsilon^{-2aX} + 2\cos 2\beta X)^{\frac{1}{2}}} \qquad (28)$$

exactly expresses the ratio of the current Ig at the grounded end of the line to the current, IX, at any point distant X from the grounded end.

For most practical purposes this last equation reduces to

$$W = \frac{Ig}{IX} = 2\, \epsilon^{-aX}$$

which is of similar form with equation $W = 2\, \epsilon^{-al}$ where l is the distance from the dynamo end of the line.

As shown by the above equations, the values of the ratios of the currents, plotted in Curves V and VI, for a line of infinite length, if multiplied by 2 become very nearly the correct values for a line 1,000 miles long grounded at its end. Thus, referring to CurveV, to have the ratio $2 \times .05 = \frac{1}{10}$th, the resistance of the line would have to be as low as 2.67 ohms per kilometer, and the line perfectly insulated. Thus 1,000 miles is about the limit of duplexing for a perfectly insulated line of No. 9 copper wire unless the line is modified by having its self-induction increased. Probably, however, as lines are actually constructed, having more or less leakage, the ratio would be $\frac{1}{10}$th in about 630 miles. (See curve, Fig. 4.)

In telegraphing with alternating currents there is no falling off in the speed of the signaling with increasing distances due to a blending together of the current impulses. A current of sine wave form entering a line preserves its sine wave form however long the line.

The rapidity with which signals can follow each other on the line is absolutely independent of the length of the line. Limitations, which have been discussed, are put upon the length of a line which can be duplexed, but none of these limitations apply to simplex lines, or lines in which it is not required to transmit two signals in opposite directions at exactly the same instant. By means of the alternating current a simplex line can be operated which is of very great length. I have personally made an artificial line equal to 1,200 miles and telegraphed over it at the rate of 160 words a minute, sent in one direction and received in printed form. The received signals were just as clear and perfect as they would have been on a line of only a few miles in length. For printing telegraphy, and for synchronism, a receiving relay could be made to operate perfectly with a small fraction of a milliampere, but such a delicate receiving instrument would be easily effected by accidental line disturbances, such as induction effects from neighboring lines, or atmospheric electrical influences. (All earth current disturbances may be entirely eliminated in ways to be shown later.)

Practical tests indicate that the receiving relay should be sensitive to about 25 milliamperes. The distance then over which full speed, clear signaling in one direction at a time can be effected, is limited only by the distance to which an alternating current of about 25 milliamperes can be forced through a well-insulated line. How long the line might be through which 25 milliamperes could be forced would depend, of course, upon many circumstances, such as its resistance, its insulation, its self-induction and capacity. It would certainly be an easy matter to telegraph 160 words per minute in one direction over a No. 9 copper wire overhead line, 1,500 miles long, and probably much farther.

There are many ways in which telegraphic signals may be impressed upon an alternating current. In explaining the more valuable methods, I shall assume that it is simple and easy to maintain synchronous rotation of the local apparatus at the two ends of a line of any length through which 25 milliamperes may be made to flow. Full explanations will be given later of how this synchronism is accomplished.

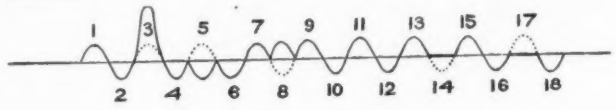


FIG. 9.—WAVES.

An alternating current of sine wave form with some of its waves modified is represented in Fig. 9. At the end of a line carrying the alternating current it is assumed that there is a receiving instrument, which is effected in a uniform manner by each of the unmodified half waves of the current, but which is differently effected whenever a modified half wave reaches it. With this arranged, it is evident that if a half wave of the current is modified at one end of the line in any particular manner, the receiving instrument at the other end will indicate the modification, and the whole or a part of a signal will have been transmitted. The two general ways in which a signal may be impressed upon the alternating current, is first to make a signal to consist of a modified single particular half wave, and, second, to make a signal to consist of a particular combination of modified half waves.

In the first instance, the half wave may be either cut out or omitted, as the half waves, 14 and 17, or reversed as the half waves 5 and 8, or altered in form as the half wave 3, Fig. 9. The cutting out and the reversing of a half wave are the only two kinds of modifications of the current which have so far been found to be of practical importance, and the only ones which I shall here consider.

A half wave or semicycle of the alternating current may be cut out or reversed in a number of different ways. But, whatever method is employed, it is desirable that the current and e. m. f. should be in phase *at the point of the line where the current is modified.* If the current and e. m. f. are not in phase, it is diffcult, if not impossible, to cut out or reverse the half wave by any transmitter method, which breaks the line circuit, without sparking at the line contacts.

In any alternating-current circuit, in which the current and e. m. f. differ in phase, there is no common point where the current and e. m. f. are both zero, and so if the circuit is broken while the current is passing through zero, the e. m. f. acting across the break produces a spark, if the circuit is broken while the e. m. f. is passing through zero the current flows across the break producing a spark.

This explanation is admittedly unsatisfactory, but experiment shows, nevertheless, if the current and e. m. f. differ in phase, that there will always be more or less sparking at whatever time the circuit is broken, and that the sparking may be avoided when there is no difference in phase.

It is very easy to bring the current and e. m. f. exactly into phase at any particular point of the line, by inserting in series with the line the proper amount of self-induction. The matter has practical importance, and I will therefore show how to calculate the proper amount of self-induction to use. The problem will be shortened if the line is considered as being infinitely long, and the result will differ from that for a line of, say ¼th wave length, by a negligible quantity.

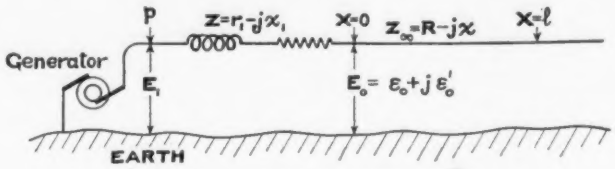


FIG. 10.—LINE OF INFINITE LENGTH.

Let Fig. 10 represent the line of infinite length. Let $X = O$ where the e. m. f. is $Eo = eo + j\, eo^1$. Suppose it is required, in order to cut out half waves, to break and make the circuit at some point, p, and that at this point the current and e. m. f. shall be brought into phase by inserting in series with the line the impedance $Z = r_1 - jx_1 = r_1 - j2\pi NL$. In general if $Z^1 = R^1 - jx^1$ is any impedance, the phase difference of the current and e. m. f. is $tan\ \omega = \frac{x^1}{R^1}$ and the current and e. m. f. are in phase if $tan\ \omega = O$.

Let Z_∞ be the total impedance of the line of infinite length, and let the impedance $Z = r_1, -jx_1$, be added between the point p and the beginning of the line, where X is taken to be zero. Then reckoning from the point p, the total impedance is $Zs = Z + Z_\infty$. The impedance of the line is $Z_\infty = \frac{Eo}{Io}$, namely the ratio of the e. m. f. to the current at the point where $X = o$. As previously shown, for a line of infinite length, the constant B in equations (9) and 10) is zero and

$$E = \frac{A\,\varepsilon^{-aX}}{g - j\,bc}\ (cos\ \beta X + j\ sin\ \beta X)$$

and

$$I = \frac{A\,\varepsilon^{-aX}}{a - i\,\beta}\ (cos\ \beta X + j\ sin\ \beta X)$$

Hence

$$Z_\infty = \frac{a - j\,\beta}{g - j\,bc} = \frac{g\,a + bc\,\beta}{g^2 + bc^2} - i\,\frac{g\,\beta - bc\,a}{g^2 + bc^2}$$

Then the total impedance counting from the point p, where it is desired to have the current and e. m. f. in phase is

$$Z_s = r_1 - i\,x_1 + \frac{g\,a + bc\,\beta}{g^2 + bc^2} - i\,\frac{g\,\beta - bc\,a}{g^2 + bc^2}, \text{ or}$$

$$Z_s = \frac{r_1\,(g^2 + bc^2) + g\,a + bc\,\beta}{g^2 + bc^2} - j\ \frac{x_1\,(g^2 + bc^2) + g\,\beta - bc\,a}{g^2 + bc^2}$$

Hence

$$tan\ \omega = \frac{x_1\,(g^2 + bc^2) + g\,\beta - bc\,a}{r_1\,(g^2 + bc^2) + g\,a + bc\,\beta}$$

The difference in phase is zero when

$$x_1\ (g^2 + bc^2) + g\,\beta - bc\,a = o$$

or when

$$2\,\pi\,N\,L = x_1 = \frac{bc\,a - g\,\beta}{g^2 + bc^2}$$

That is when

$$L = \frac{bc\,a - g\,\beta}{2\,\pi\,N\,(g^2 + bc^2)}$$

If the leakage is zero, that is if $g = o$

$$L = \frac{a}{2\,\pi\,N\,bc} = \frac{\sqrt{\frac{bc}{2}}\ \sqrt{(r^2 + x^2)^{\frac{1}{2}} - x}}{2\,\pi\,N\,bc}$$

or

$$L = \frac{\sqrt{(r^2 + x^2)^{\frac{1}{2}} - x}}{\sqrt{8}\,\pi\,N\,\sqrt{bc}}$$

Adopting the same values for the constants of the line as were used in plotting curves I to IV we get

$$L = \frac{\sqrt{(2.67^2 + 1.13^2)^{\frac{1}{2}} - 1.13}}{\sqrt{8} \times 3.14 \times 100 \times \sqrt{3.89 \times 10^{-6}}}$$

or $L = \frac{7.6}{100}$ henrys.

The self-induction required to bring the current and e. m. f. into phase at the beginning of lines of finite length such as would actually be used, is but slightly different from the self-induction required for a line of infinite length.

I have found the expression for the necessary value of L in the case of a line ¼th wave length long.

It is

$$L = \frac{bc\,a - g\,\beta}{2\,\pi\,N\,(g^2 + bc^2)} \left[\frac{\varepsilon^{\frac{a\pi}{2\beta}} + \varepsilon^{-\frac{a\pi}{2\beta}}}{\varepsilon^{\frac{a\pi}{2\beta}} - \varepsilon^{-\frac{a\pi}{2\beta}}} \right]$$

The expression in brackets differs from unity by only a very small quantity and otherwise the expression for L is the same as that obtained for a line of infinite length.

The most obvious method of cutting out a single half wave of the alternating current, is to break the circuit when the current is passing through zero and to again complete the circuit after the time of passing of a half wave of the current. An endless number of contrivances might be devised for doing this. Two only will be given to illustrate the principle.

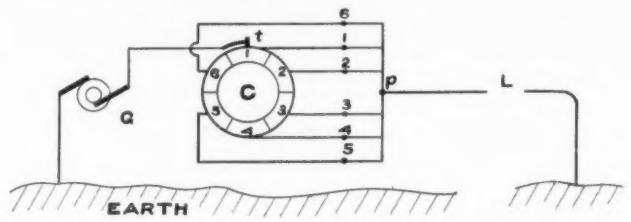


FIG. 11.—METHOD OF CUTTING OUT SINGLE HALF WAVES.

Let C be a sunflower device consisting of segments 1, 2, 3, etc., insulated from one another. Let t be a trailer which, by mechanical gearing to the axle of the generator G, passes over one segment of the sunflower for each half wave of the alternating current. Then if the segments are joined to a common point, p, an alternating current will pass down the line L. Now, if at any of the points 1, 2, 3, 4, etc., one of the segments is disconnected from the common junction p, when the trailer comes around to the disconnected segment no current will be given to the line L, and the half wave will be cut out. Any number of half waves can be thus cut out during one revolution of the trailer by disconnecting any number of segments from the point p. The breaks at 1, 2, 3, 4 can be made with keys, or other suitable devices.

Wireless Telegraph from Berlin to Venice.

A Berlin cablegram, of November 8, says: A wireless telegraph station between Berlin and Venice, with a range of 800 kilometers, will be established this winter at Ober-Schoeneweide, near Berlin, for a trial. If it proves successful for that distance, it will take in Calais on the west, Stockholm on the north and Lemberg, in Galicia, on the east. The equipment for the station, which will be that of the Slaby-Arco system, will be built here by the German Electric Company. Its capacity will correspond to that of the Marconi station at Poldhu, Cornwall, England, and the cost of installation will be $50,000. The annual report of the German Electric Company says the crisis in the electrical industry has been caused chiefly by the careless conduct of affairs. It recommends closer unions of big firms.

Cleveland as a Center in Electrochemical Development.

By Cecil L. Saunders.

It is an interesting but not generally known fact, that the great development now occurring in the electrochemical industry had its beginnings in Cleveland, O. It was here that the first large carbons were made at the Brush Carbon Works, for use in the Cowles Brothers' electrical furnaces, and at the present time all the carbon electrodes in use in the various processes are still made in Cleveland. It was here that the first large electrochemical dynamos (then the largest in the world) were made and designed by Charles F. Brush for use in this work. It was in Cleveland that the rare products from the electric furnace were first made, including the reduction of the metal aluminum from its refractory ores.

Thomas L. Willson, who claims the discovery of calcium carbide, was in the fall of 1885, an employee of the Brush Company at its works in Cleveland, where the Cowles Brothers were then operating their electric furnace. Mr. Willson afterwards began experimenting with the electric furnace at Spray, N. C., in 1888, and developed a product, calcium carbide, from which acetylene is made. On the basis of Willson's work and under a license from the Cowles patents, a plant employing 13,000 horse-power and hundreds of men, is now operated at Niagara Falls, producing this remarkable substance. It was here at the chemical laboratories of Case School, during the years 1889 and 1890, that Herbert H. Dow conducted his electrochemical experiments and perfected the processes now used by the Dow Chemical Co. and The Midland Chemical Co. in their large factories in Midland, Mich., for the manufacture of bleaching powder and bromides.

It was in Cleveland that Chas. B. Taylor, then engaged in manufacturing carbon bisulphide by the old chemical method, studied and experimented with the Cowles furnace and developed his electrical process for same, and who now uses a thousand horse-power at Penn Yan, N. Y. It was here at its experimental factory that the Canadian Copper Co. of Sudbury, Ontario, carried on for years a long series of experiments with electrochemical processes for the reduction of nickel from its ores, bringing to the city many of the best known electrochemists of Europe to work out the problems involved, and which after a large expenditure of money have resulted in the successful solution of the problem by the painstaking, careful experimentalist David H. Brown, and the adoption of his process to be installed in mammoth works soon to be erected.

At Niagara Falls a large works is in operation producing all the phosphorus that is used in America by means of the electric furnace. This is also an outgrowth of the work that was started in Cleveland in 1885. A Dr. Redman, in 1890, perfected this process at the works of the Cowles Syndicate Co. at Stoke-on-Trent, in England, in one of the Cowles Brothers' furnaces, and the process is at present worked at Niagara Falls in a manner very similar to that described in some of the Cowles patents.

In 1886 the Cowles Syndicate Co., in England, was organized, and erected electric smelting works at Stoke-on-Trent. In 1894 this company was reorganized as The British Aluminum Co. with great works at the Falls of the Foyers in Scotland, where all the calcium carbide and aluminum of England are now produced.

In 1888, a group of wealthy Berlin capitalists were gotten together by agents of the Cowles Company of Cleveland, to purchase their European patents. The purchase was never consummated. An American, Grosvenor P. Lowrey, brought to the attention of this group, the experiments of a Dr. Kleiner Fiertz and one Paul Herault, who were experimenting with the electric furnace at the Falls of the Rhine in Switzerland. As there were no patent laws in Switzerland at that time, these capitalists arranged with these gentlemen, and on their work founded the great establishment at Schaufhausen, that now produces most of the aluminum, and a large amount of the calcium carbide, for Europe.

Edward G. Acheson, is a learned scientist as well as brilliant experimentalist, whose first work was in the laboratory of Thomas A. Edison. In 1890 he began experimenting with the Cowles furnace with the idea of producing diamonds. He produced some hard, lustrous crystals, carbide of silicon, which he afterwards named carborundum, and began manufacturing these crystals at Monongahela, Pa., as a substitute for emery and other abrasives. The large factories at Niagara Falls using 5,000 horse-power and employing hundreds of men, testify to his genuis and executive ability, as well as the commercial value of this product, now made in the greatest electric furnace in the world, a furnace the size and magnitude of which was undreamt of and inconceivable in 1884 when the Cowles Brothers were experimenting with their wonder of the age. All credit for the product is due him, but the United States Circuit Court of Appeals at Philadelphia recently adjudged his process an infringement of one of the patents of the Cleveland inventors. The Court in that opinion, says, referring to carborundum: "So long ago as 1884 the Messrs. Cowles produced it under their process. . . . It is true they did not manufacture it for commercial purposes, and failing to appreciate its importance, though aware of its abrasive qualities, applied their process to other branches of metallurgy."

Between the years 1885 and 1890, the Cowles Electric Smelting & Aluminum Co. and its branch company in England, first offered aluminum to the market in a cheap form. It supplied cheap aluminum alloys in large quantities, and one of the great demands for aluminum to-day is for use in addition to steel. A very small percentage alloyed with steel so improves the casting qualities of the steel that the steel casting business has been enabled to develop into great magnitude since 1886. Before the Pittsburg Reduction Co. began to manufacture, this market was fully developed and supplied a ready demand for its product as soon as it was offered for sale. Mr. Charles M. Hall, upon whose patent the Pittsburg Reduction Co. was organized, was from Oberlin, a few miles from Cleveland, and from July 1887 to July 1888, he experimented with his process at the works of the Cowles Electric Smelting & Aluminum Co. at Lockport, N. Y. At that time his process was not an electric smelting process, and was of a nature that could not in any way conflict with patents owned by the Cowles Company. Mr. Romaine C. Cole was led to believe that the process could be converted into a commercial process following the lines of Mr. Hall's patent and experimental work.

The Pittsburg Reduction Co. was organized, and changes which led to success in the production of pure aluminum also led to a patent suit between The Cowles Electric Smelting & Aluminum Co. and The Pittsburg Reduction Co., which contest has been going on in the courts for the past eleven years. Before that date the Cowles Company had announced in their trade pamphlets that they proposed soon to put pure aluminum on the market, though up to that time it had only been offering the alloys.

Charles S. Bradley, the well-known electrical engineer and experimentalist, was also from the laboratory of Thomas Edison, and has recently brought out three successful electric smelting processes at Niagara Falls, one for making cyanides, another for making barium hydrate, and another by which ammonia products are produced from the atmosphere. Again, Mr. Bradley was early connected with the aluminum business. His patents were in litigation with those of the Cowles Brothers in 1885. They were patents much of the nature of those of the Cowles Brothers and had in view heating large masses of material by the electric current, and the electrolytic production of aluminum. All of Mr. Bradley's inventions that did or might interfere with the patents or patent applications of the Cowles Brothers, were purchased by the Cleveland company, but unfortunately and to its great financial embarrassment, there arose over this assignment, protracted litigation which was only settled and the issue decided in favor of the Cowles Company, in 1897.

In connection with the foregoing, the following extracts from a paper read before the American Association for the Advancement of Science in 1885, by Professor Charles F. Mabery of Case School, are interesting historically:

"A short time since Eugene H. Cowles and Alfred H. Cowles of Cleveland, conceived the idea of obtaining a continuous high temperature on an extended scale by introducing into the path of an electric current some material that would afford the requisite resistance, thereby producing a corresponding increase in the temperature. After numerous experiments that need not be described in detail, coarsely pulverized carbon was selected as the best means for maintaining a variable resistance, and, at the same time as the most available substance for the reduction of oxides. When

this material, mixed with the oxide to be reduced, was made a part of the electric circuit in a fire-clay retort and submitted to the action of a current from a powerful dynamo machine, not only was the reduction accomplished, but the temperature increased to such an extent that the whole interior of the retort fused completely. In other experiments, lumps of lime, sand and corundum were fused, with indications of a reduction of the corresponding metal; on cooling, the lime formed large well defined crystals, the corundum beautiful red, green and blue hexagonal crystals."

"Experiments already made show that aluminum, silicon, boron, manganese, magnesium, sodium and potassium can be reduced from their oxides with ease. In fact there is no oxide that can withstand temperatures attainable in this electrical furnace. Charcoal in considerable quantities is changed to graphite; whether this indicates fusion or solution of carbon in the reduced metal has not been fully determined. As to what can be accomplished by converting enormous electrical energy into heat within its limited space, it can only be said that it opens the way into an extensive field for pure and applied chemistry. It is not difficult to conceive of temperatures limited only by the capability of carbon to resist fusion."

At this early date the Cleveland Cowles Company had recognized the importance of incandescence in electric smelting, in counterdistinction to the arc methods, which have never proven successful. It had recognized the economies that can be effected in operating upon large masses of material in electric fusion. It had recognized that refractory materials could be reduced at prices that would render their products of value to the world, and during the year 1885, they were offering and selling aluminum in their alloys, at a price of $3.00 a pound, which was soon thereafter much lowered. Speaking of its process, Dr. T. Sterry Hunt, in a paper read before the American Institute of Mining Engineers, in September, 1885, said:

"The vast importance of the new instrument which the Messrs. Cowles have placed in the hands of chemists for producing and controlling a degree of temperature never before obtained, can scarcely yet be estimated, either in its economic or its scientific results. The heat of the furnace realizes the alkahest or universal solvent so long the dream of the alchemist, and he who can rightly use it will be worthy of the ancient title of *magister magnis in ignis*.

"Up to the present time, most of the work that has been done in the electric furnace has been that of reducing aluminum direct from corundum and clay, and also the smelting of silica, common white sand or pebbles to produce silicon bronze. From our knowledge that we have of the process, we are positive that it is designed to work a revolution. . . . . We base this prediction upon the fact that by the new process, aluminum can be produced in its alloys so much cheaper than ever before. The production of pure aluminum cheaply, which is assured by the new process, is, however, also of great importance as this wonderful metal is, with the exception of calcium and silicon, the most abundant component of the earth. Its lightness, non-oxidizability and strength, as well as great power to conduct heat and electricity, render it in many respects the most astonishing of metals."

How wonderfully his prediction has come true, and what a revolution of manufacturing chemistry, as well as the reduction of metals from their ores, has been accomplished. To-day we find on the markets of the world metals and products formerly unknown. Fortunes are being rapidly made. The inventors of successful products and the more economical processes are receiving their well-deserved reward. The enormous amount of capital now invested in the electrochemical processes and power plants for same, attest their great commercial value and the confidence of the investing public. From this small beginning of the Cowles Brothers, an industrial revolution has encircled the world. The electrochemical scientist has penetrated the mountains, forests and deserts. Water powers and surrounding lands of no value have become industrial centers, teeming with the highest civilization and activity from where the electrometallurgists of to-day are sending forth their additions to chemical technology. All that has been done is only the beginning. Industrial centers will change. Present manufacturing processes and plants will be discontinued, and new cities with plants using processes and making products of electrochemistry, now unknown, will be established. Steel will be made direct from the ore, and rolled or cast in all its forms at the mine, using electric heat and power derived from adjacent water powers. Progressive colleges have recognized the value of the new science, and established courses with laboratories for the student of electrochemistry. All is change, eternal progress, no death.

The Composition of Porcelains for Electrical Purposes.

The current issue of the *Transactions* of the American Ceramic Society contains a paper by Mr. Arthur S. Watts, of Findlay, Ohio, giving the results of exhaustive tests on electrical insulating porcelain. The tests, which extended over several months, were extremely complete, covering almost the entire range of earth insulating material. The paper includes numerous tables, giving full data of the tests. Below we give an abstract of the more general parts of the paper:

The leading materials used in porcelain manufacture are certain kinds of kaolin, which are very slightly plastic, quartz and feldspar. Of course ordinary feldspar displays basic properties in the fire, uniting with silica to form silicates, thus producing an intimate mixture of all silicates. Therefore, the contents of kaolin must be in a definite ratio to the quartz and feldspar in regard to the insulating properties.

Too much quartz makes the body too little plastic, thus making it difficult to work, and after burning, the ware shows impressions and some warping due to the tendency of the clay substance to the contract. Too high a content of feldspar makes the body soft and liquid, and increases the tendency to crack. A body low in feldspar does not produce sufficient vitrification, and hence decreases its insulating efficiency.

A porcelain body may shrink 15 to 18 per cent., and it is very important that the exact degree of shrinkage be known. No crazing or shivering is allowable in the glaze used on ware for electrical materials. If the glaze is too infusible the ware will be dull, and if too fusible it is likely to be covered with blisters. Investigation has proven the condemnation of glazes containing metallic oxides to be unfair. Metallic oxides, when used in glazes combine with the silica, forming silicates.

Probably in no line of electrical investigation have greater progress and more varied experiments been made than in the shape and size of electrical insulators. The plain bell which is used for low potentials, and which is also practical and satisfactory for alternating currents up to 1,000 volts, does not meet the requirements of modern high voltage transmissions.

The first step in the way of improvement was made in 1857, by Borggreve. The product was satisfactory so far as electrical and mechanical requirements were concerned, but failed owing to the fact that the interior space was square, which gave rise to uneven tensions in the body and frequent fractures.

The second step in the way of improvement was the production of a very long insulator having a very narrow cross-section. It was the idea of the inventor to increase the resistance by means of a long arcing distance. The insulator produced was of clear glass and suffered from the contraction and expansion of the iron bolt used to connect it to the cross-arm, and which became intensely hot from the sun's rays on the insulator. This condition caused the introduction, in 1895, of the double bell insulator of porcelain. In this, the interior cylindrical part of the insulator is covered by a second bell, which prevents the radiation of heat and also the formation of dew.

Up to a tension of 3,000 volts, the ordinary double bell, 75 mm. wide and 100 mm. high, suffices, but above this voltage the question of further improvement arises.

In 1869 Lenoir and Prudhomme obtained a patent for the use of oil in insulator bells. Insulators of this type were used in constructing the famous line between Lauffen and Frankfurt. They proved impractical, as the oil must be replaced frequently, and in case of rain it was often replaced by water.

In constructing the Kaiser Wilhelm Canal Line, a triple-bell insulator, without oil, was used, and proved satisfactory even when exposed to salt spray. This type is now commonly in use for high-voltage transmissions.

At first the insulators were glazed and burned, resting on the bottom edge of the bell, but the roughness of this edge seemed to cause the collection of drops of water and to prevent this, the insulator is now glazed all over, the glaze removed from the head and the insulator burned inverted. Very recently it has been discovered that by glazing the inside of the insulator in the threaded

hole, the insulator is made much more resistant and need not be so thick.

The weight of the porcelain used in an insulator is not of the greatest importance, but rather, the quality of the porcelain and the kind of glaze.

In Europe, insulators are made by all five of the clay working processes, viz., turning, jollying, pressing, casting and dry pressing. Dr. Seger, in his work, shows very conclusively that a semi-dry process, in which the material to be pressed contains the highest per cent. of water allowing of good pressing, gives the densest and strongest body.

Turning of large insulators is done similarly to all clay turning, the product being made mouth up, and the top finished when the ware is sufficiently dry to permit of its being inverted. In this class of ware, much trouble is experienced in making the screw-thread for the pin which is to support the insulator. This thread is made by means of a threaded steel tube, which is provided with a handle on one end, and which is slowly turned in and out. In place of a full steel tube a segment may be used. Automatic boring apparatus is now being applied for this work.

Jollying is now largely replacing turning although it does not insure as dense and uniform a body as the former process. Pressing is done in molds. The clay is placed in the mold in a lump and by means of a plunger is forced to assume the shape of the inside of the mold for its exterior while the plunger shapes its interior.

Dry pressing produces more exact shapes than any other method. The molds used are of steel and are very expensive. The body must be in such shape that it will not stick to the mold. To obtain it in this condition some factories use the following process: The clay after drying and being thoroughly pulverized is placed in wet cement or plaster boxes and allowed to absorb 10 to 20 per cent. of moisture. The mass is then sieved thoroughly. Ten kilograms of the body will contain about 1 to 2 litres of water. Of course this proportion must be maintained exactly in order to insure a uniform shrinkage. The molds are sometimes complicated and are often composed of insertions. The piece of ware produced is threaded by means of a screw inserted in the bottom before the clay is introduced, and which is screwed out rapidly by means of a crank. The tendency is to make insulators without threads, as this has always been a great source of trouble and loss in manufacture.

Mr. Watts said that in outlining his tests, it seemed necessary to choose some type or standard of porcelain which could be used as a basis from which to map out varying series. The wisest course seemed to be to procure a large number of standard porcelains, and to obtain from these by comparison the most characteristic type of porcelain now in use. Acting on Professor Binn's suggestion,* Al_2O_3 was taken as unity in the formulas.

An examination of the chemical formulas of 36 specimens at first sight appeared to indicate a hopeless conglomeration, ranging to all extremes; but closer study disclosed the fact that, while the *RO* varies from .0467 in the Japanese to 5.43 in the old English, and from .114 in modern Belgium to 1.84 in modern English ware, the proportion of SiO_2 is comparatively constant. Only in two out of 36 cases does the SiO_2 run below 3.7, and in only two cases of modern porcelain does it run over 6.0 SiO_2. The average of the list was between 4 SiO_2 and 4.4 SiO_2, hence 4.2 SiO_2 was taken as the standard.

Next a standard for *RO* was chosen. To obtain this by the same method as pursued with the SiO_2 would prove unsatisfactory, since to take an average of the entire list would result in a *RO* of 1.00, while to take an average of the 30 modern porcelains would give about 0.3 *RO*. The first case would give about a cone 6 product, while the second case gives very nearly the type of an American porcelain, maturing at cone 12. As a choice between such extremes could not be satisfactory, a series was made, covering each extreme and a third about half-way between, as follows:

Series A	1. RO,	1. Al_2O_3,	4.2 SiO_2	Cone 6 type.
Series B.	.5 RO,	1. Al_2O_3,	4.2 SiO_2	Cone 9 type.
Series C.	.3 RO,	1. Al_2O_3,	4.2 SiO_2	Cone 12 type.

The various porcelain trial bodies were produced in the following manner:

The two extremes of each set were weighed out and ground wet in a ball mill. The intermediate numbers were obtained by liquid blending of the extremes. After the blends were thoroughly mixed, they were poured into plaster molds to harden by loss of their water. Of each porcelain body the following ware was made:

Two brickettes made in standard cement—brickette molds—and having a central cross-section of 1 inch in the green state. These were made by the plastic process. Two cubes of 50 grams weight, made also by the plastic process. Two tiles, 4½ inches x 4½ inches, in green state. These were made by the dry-press process.

The material for the dry-pressed tile was prepared as follows: The dry body was thoroughly pulverized and was then dampened with water by means of a brush and the hand, thus obtaining a fairly uniform dampness. The damp clay was allowed to stand about two hours, and was then put through a 20-mesh screen and promptly pressed into the desired shape by means of a hand tile press. About 12 to 14 per cent. of water was in the clay when it was pressed.

Upon the various forms made up, there were made an electrical resistance test, tensile test, abrasion test, absorption test and shrinkage test.

While no great obstacle lay in the way of the tensile, abrasion, absorption or shrinkage tests, the difficulty was great with respect to testing the electrical resisting properties of the porcelains. In the first place, it was not known how much electrical resistance a given thickness of porcelain might display. In the second place there could be pressed only a tile of one size, viz., 4½ inches x 4½ inches. It was thus necessary to obtain, if possible, some insulating material in which to imbed the tile, and thus increase the arcing distance of the current, since with 4½ inches arcing distance 55,000 volts could not be used without the current arcing around the tile. The idea of using Portland cement, however, suggested itself, as it seemed plausible that this might be a good insulating material.

A semi-vitrified tile, 4 x 4 x ⅜ inches, was incased in a slab of Portland cement (Dyckerhoff). The cement was carefully tamped around the tile, so that a good attachment might result. Several other slabs were also made of cement, both German and American. In these no tiles were encased. All the cement slabs stood six days in water, and were then taken out and carefully dried. Their resisting properties were then tested with poor results. Each slab showed only so much electrical resistance as a like thickness of pure air would show, thus proving that the small insulating power displayed by the cement was due to the fact that its thickness held the electrodes apart and made an arc necessary.

Next the tile was tested encased in cement. The following insulating materials had also been provided: One sheet window glass, one sheet plate glass, one porcelain tea plate, one tile 4 x 4 x ⅜ inches unincased. The results of the test of the above was as follows:

Tile 4 x 4 x ⅜ inches, incased in slab of Portland cement, punctured at	17,000 volts.
Tile 4 x 4 x ⅜ inches, unincased, punctured	20,250 "
Sheet window glass 6 x 6 x ⅛ inches, punctured at	40,000 "
Porcelain Tea Plate, 6 inches in diameter x ⅛ inch, punctured at	49,500 "
Sheet Plate Glass, 6 x 6 x ¼ inches, stood 60,000 volts, and then the current arced around sheet and could not puncture it.	

The tile incased in cement and the unincased tile were both of the same composition, and as both were porous to a degree, it is to be presumed that the incased tile which had been soaked for six days still retained some moisture when tested, which accounts for its lower puncturing point than was displayed by the unincased tile. The facts brought out by this preliminary test seem about as follows:

First.—That Portland cement does not possess any more insulating power than would be displayed by a like thickness of dry air.

Second.—That porcelain, if not perfectly vitrified, does not possess any great insulating efficiency, even when perfectly dry.

Third.—That glass ranks next and lies between semi-vitrified and vitrified porcelain.

Fourth.—That thoroughly vitrified porcelain, even though only ⅛-inch thick, possesses as much insulating strength as is necessary, since 40,000 volts is the highest voltage that can be transmitted without arcing around a 4½ x 4½ inch tile.

Fifth.—That plate glass possesses an especially high electrical resisting property.

We know that the composition of glasses has a great influence on their ability to resist electric currents. Also, that the temperature at which they are used is a factor.

The search for an aproning material to use with the tiles was continued, and it was found that a gutta-percha plate could not be

* The Birth of English Porcelain, Trans. A. C. S., Vol. III, page 144.

cemented to the tile for each test and then removed, and to furnish a separate sheet of gutta-percha for each tile would mean entirely too great an expense. Selenium also was out of the question owing to its cost. It was concluded, however, to try sulphur, which is a very similar material to selenium, and to do this two bottomless flasks, by means of sulphur in the melted state, were cemented to two tiles. Two large plates of sulphur were also cast with tiles imbedded in their centers. One tile was completely imbedded, leaving only a hole ½ inch in diameter on each side to admit the electrode. The second tile was only imbedded on one side in the sulphur, the other side was left exposed. There was a ½-inch hole on the imbedded side of the tile to admit the electrode. The tiles were vitrified. A plate of sulphur, 6 x 6 x ½ inches, was also cast. The results of the electrical test on sulphur was as follows:

The plate containing the half imbedded slab stood about 58,000 volts, and then the current arced through the sulphur. The plate containing the completely imbedded tile stood about the same, the current going around the tile through the sulphur. The tiles cemented to the flasks were not satisfactory since the current found its way between the glass and the sulphur. The slab of pure sulphur ½-inch thick stood about 13,500 volts and then punctured. On its being punctured the slab caught fire from the spark.

The results showing that at least none of the materials available could be successfully used as an aproning material, the idea was discarded of aproning the tiles, and the thickness of the pieces to be tested electrically was reduced to an amount which would puncture before the current would arc around the tile.

The formulas of the three porcelains selected as fairly illustrating the types now in actual use have been given. Taking each type, as a basis, three separate sub-series of bodies were made, as follows, each sub-series consisting of a set of five porcelains:

I. Maintaining *RO* and SiO_2 constant and varying the proportion of Al_2O_3.

II. Maintaining the Al_2O_3 to SiO_2 constant and varying the ***RO*** in kind but not in quality.

III. Maintaining the *RO* and Al_2O_3 constant and varying the proportion of SiO_2.

PREPARATION OF THE REGULAR TRIAL PIECES.

The preliminary tests having been completed, the various bodies were prepared on sufficient scale, and were worked into the shapes heretofore decided upon, and after drying each lot thoroughly, they were fired. It was impossible to obtain in the small kiln used an absolutely uniform temperature over the entire kiln, but except in one case, all received an equal period of firing.

The paper discusses in detail the results of each set of tests, consisting of tests for electrical resistance, abrasion, absorption, shrinkage and tensile strength. Following are the conclusions arrived at:

The object of the investigation was to prove, if possible, the proportions of the essential constituents which go to make up the best insulating porcelains. The tests showed that porcelains of equally good appearance may possess greatly varying values when subjected to various tests. The essential properties of an electrical insulator are, that it possess, first of all, a high efficiency as a non-conductor; second, that it stand, without snapping, any reasonable strain put upon it by the exigencies of wiring; third, that it withstand the blows of missiles, even bullets, without breaking. The electrical, the tensile and the abrasion tests, respectively, were made to show these properties in the porcelains tested.

The electrical resistance tests show that every specimen standing a superior test has a high silica and moderately low alumina content. Unfortunately in each series showing the variation in proportions of *CaO* and K_2O, the content of Al_2O_3 was so high that no exceptionally good porcelains were obtained, even with high K_2O content. However, the tables show that a marked improvement is apparent upon increasing the K_2O and decreasing the *CaO*, except at the extreme of the series where we see the K_2O used alone, and here the specimens show weakness due to brittleness. This indicates that had the K_2O been somewhat increased, and the *CaO* proportionately decreased, the result would have been much better.

From a study of the abrasion tests, it is very apparent that with K_2O alone as a flux, and even with a moderately high clay substance, we obtain a brittle and weak porcelain. When as low as 20 per cent of K_2O is replaced by *CaO*, we find the product changed to a tough but well vitrified body, although the translucency is reduced by any additions of *CaO*. To just what extent this is the case is not a matter of importance in this work. In the series showing the effect of Al_2O_3 content, no great difference was noticed in the ability of the specimens to resist abrasion. Much the same statement would apply to the series showing the results of varying of SiO_2. However, the medium high SiO_2 specimens seem to clip worse than the extremely high SiO_2 specimens, while the low SiO_2 specimens show a lack of ability to resist abrasion.

A study of the test tables show that of the forty different porcelains tested, six are more or less porous. It appears that the results of the tensile tests hold here also, and that the same limits may be accepted. Moreover, *CaO*, when substituted for an equal equivalent of K_2O, does not produce an equal amount of vitrification with all cones.

A study of the tensile tests show that a moderately high SiO_2 and Al_2O_3 content will bring a good strong porcelain, but that not over one Al_2O_3 and 6.2 SiO_2 should be used. None of the specimens below .8 Al_2O_3 and 4.2 SiO_2 were safe, owing to their very narrow vitrification limits. The *RO* that proved most satisfactory in the tensile tests was between

40 per cent. K_2C	and	80 per cent. K_2O
60 per cent. CaO		20 per cent. CaO

The shrinkage tests tend to show that there are three factors that may cause a variation: 1. The amount of clay substance introduced. 2. The variation in the kind of flux used. 3. The amount of silica present. Hence the shrinkage may be varied to suit almost any case.

An ideal porcelain for electrical purposes, may contain from 50 per cent. to 80 per cent. of its *RO* in the form of K_2O, and the remainder as *CaO*. It may contain from .8 Al_2O_3 to 1.0 Al_2O_3, and from 4.2 *SiO* to 6.2 SiO_2. Expressing the same fact in formula form, we would have

$$\left.\begin{matrix}0.5 \text{ to } 0.8\ K_2O \\ 0.5 \text{ to } 0.2\ CaO.\end{matrix}\right\} \quad 0.8 \text{ to } 1.0\ Al_2O_3 \quad \left\{ \quad 4.2 \text{ to } 6.2\ SiO_2\right.$$

as the practical range of composition. Closer limits than these would be largely a matter of fancy for more translucency or more stoniness to be decided by the party interested. However, any porcelain within the limits named above, would, all other things being equal, be as good as, if not superior to the average electrical insulator porcelain now on the market.

New Telephone Patents.

It is quite interesting to see in last week's Patent Office issue evidence of the practical application of the "loading" of telephone lines, according to the patents of Dr. Pupin, by the issuance of patent to Mr. E. W. Colfitts, and assigned by him to the American Telephone and Telegraph Company, the successors of the American Bell Company. This patent has reference to arrangements of circuit, whereby a loaded line may be made available for use for simultaneous telegraphy and telephony, according to the present practice of the Bell Long-Distance Company. According to these practices, a single metallic circuit is available for the simultaneous transmission of three messages, two telegraph and one telephone. The telegraph signals each follow a path comprising one wire of the metalic-circuit line, and an earth return, while the telephone currents follow the metallic circuit just as though the telegraph apparatus did not exist. This simultaneous use of the wires depends upon the very different characteristics of the telegraph and telephone currents and the consequent ability to separate them by the judicious and proper disposition of condensers and retardation coils in the circuit.

When loading, coils are used in a telephone line; however, it is found that in order to obtain the full advantage of these, a higher potential variation must be maintained upon the loaded portion of the line than at the unloaded terminal loops, and this is obtained by the use of terminal induction coils, whose ratio of transformation, Mr. Colpitts states, should be as one to three. This induction coil or transformer not only connects the two wires of the metallic circuit together, but it also breaks their continuity for direct currents, thereby rendering them unfit for telegraph service. The present invention obviates these difficulties by making the two-line wires continuous and at the same time retaining the transformer in such relation to the line that its action is not impaired. Three methods of accomplishing this result are described in the patent, all of which methods are shown in Fig. 1. In that scheme, shown at the top of the figure, the induction coil windings are split, each into two equal sections, which are connected together through condensers. With such an arrangement, the voice currents can traverse the wind-

ings of the transformer or induction coil, passing through the condensers, just as though the windings were continuous. Also, as there is an equal portion of each coil on each side of the condenser, the condenser terminals represent equipotential points as far as the alternating telephone currents are concerned, and, therefore, conductors may connect the corresponding sections of the primary and secondary windings of the transformer without effect upon these currents. These connecting conductors complete the continuity of the two-line wires for the direct or telegraphic currents. In the scheme of wiring, shown in the middle of Fig. 1, four condensers separate the transformer from the line wire, and the continuity of these latter is completed by means of low-resistance, high-impedance coils, connecting the line and terminal sections of the circuit. These coils produce no effect upon the functions of the transformers, because their impedance to the telephonic currents is so great in comparison to that of the transformer. The third method of wiring shows a slight modification in the disposition of the condensers, and of the transformer windings.

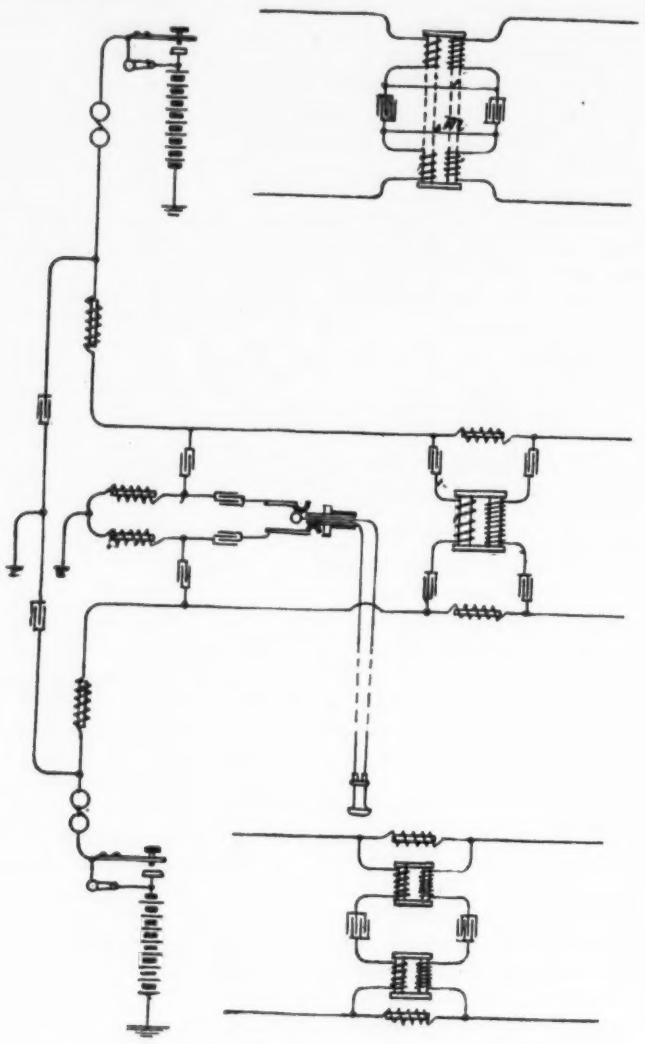


FIG. 1.—COLPITTS' COMPOSITE TRANSMISSION SYSTEM.

A second patent, assigned to the same company, is that of Mr. D. S. Hulfish, covering a connecting-cord circuit for the common battery system, in which the system of supervisory signals is worked out on lines quite different from the present standard Bell practice. This cord circuit is shown in Fig. 2, wherein P is the answering, and P^2 the calling plug. As customary, a supervisory relay, RR^2, is wired in each cord, but in addition a relay, N, is added to the circuit. When the plug P is inserted in a subscriber's spring jack, the sleeve, P^3, is grounded through the cut-off relay, while the tip and ring, p and p^2, are connected together through the subscriber's transmitter. Current is flowing in the sleeve circuit, but the lamp, S, is not glowing, as the shunt, r, controlled by the relay, R, is closed. The shunt circuit may be traced through the contacts of the relay, N.

Now, when the sleeve-wire circuit of plug P^2 is completed by the insertion of that plug into the jack of the called line, and the called party answers, instead of the relay, R^2, merely shunting its lamp, S^2, in the usual manner, this relay causes relay N to operate. As shown in the figure, the result of the operation of this relay is a complete rearrangement of circuit, by means of which both supervisory lamps are placed under the control of the shunt r, and this in turn is placed under the control of both supervisory relays. Therefore, if the shunt circuit is broken, both lamps light simultaneously, and in addition either relay breaks the shunt circuit. The combined result is that if either subscriber return his receiver to the hook after connection has once been made, the disconnect signal is given.

A patent granted to Mr. Arthur T. M. Thomson bears the title, "Electrical Relay." This device is designed, the inventor states, to

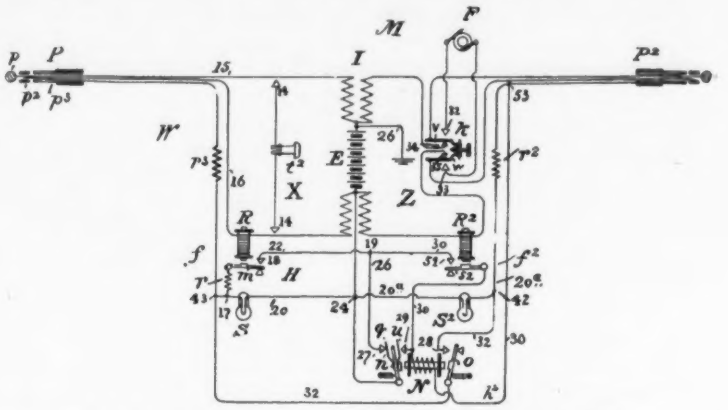


FIG. 2.—HULFISH SWITCHBOARD AND SIGNAL CIRCUIT.

automatically ring up on a called subscriber's line upon the insertion of the operator's plug into the jack, and it is arranged to continue the ringing for a considerable and predetermined length of time. Three different designs for the apparatus are shown in the patent, but all are based upon the same principle. When the plug is inserted into the jack, a circuit is closed, which operates an electromagnetic ringing key, and also sets in operation a timing device. This timing device controls a second electromagnet, adapted to restore the first to the normal position and stop the ringing. There seems to be little difference in the value of the various modifications, as the timing devices are somewhat crude, when viewed from a telephone standpoint. The first of these timing devices is an electrically-operated thermostadt, arranged to control a contact. The second is a train of gears, driving a revolving air vane and opposing the action of the armature of an electromagnet. The third is an electric motor, which is required to drive a contact wheel, by means of a reducing train, through one revolution.

A new development of the coin collector for telephone pay stations is brought out in this issue by patents. This type of coin collector is adapted to control the telephone instrument to which it is attached by locking the hook switch in the depressed position. One of these patents is granted to Mr. E. G. Lewis, another to G. P. Moore, which latter seems to be merely an improvement of the invention of Mr. Lewis. Both patents are assigned to the Controller Company.

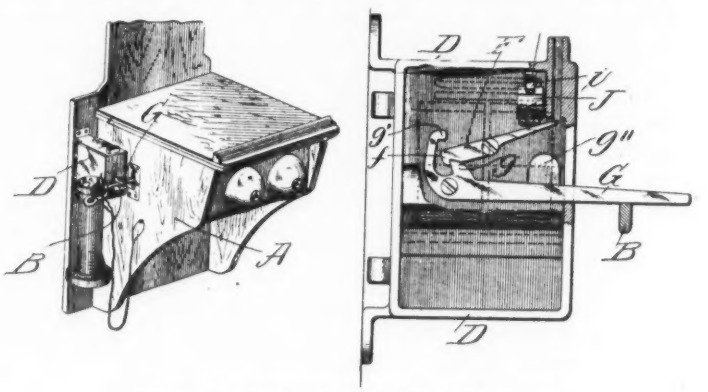


FIG. 3.—LEWIS COIN-COLLECTOR TELEPHONE.

Fig. 3 shows, at its upper left-hand corner, the device of Mr. Lewis, attached to a common battery wall set. Immediately to the right of this is shown the hook-switch lock in section. Normally, the tooth, g, of the locking bar so engages the nib, f, of the lever, F, that the bar is locked down upon the hook switch of the telephone set. If a coin be placed in the slot, in falling it strikes the lever F, and the weight of the coin overbalances this lever, causing the nib, f, to clear the tooth, g. The coin is at this time, however, retained in

the slot, for the lever strikes the projection, g^1, of the locking bar, and, therefore, is prevented from moving a distance sufficient to allow the coin to leave the slot. When the receiver is removed from the hook and this latter rises carrying with it the locking bar, the projection, g^1, clears the lever and releases the coin. After a coin is once deposited, and before the operator answers, it is evident that the subscriber must use care not to depress his hook or he will lose both his money and his call. For incoming calls, an electromagnet, controlled from the central office, is provided, which serves to release the hook switch. Mr. Moore's invention consists in the substitution of a sliding bolt for the pivoted locking bar of the apparatus just described, and performs its functions in an exactly similar manner.

CURRENT NEWS AND NOTES

NO COAL; NO CARS.—At Knoxville, Tenn., on November 8, the city was in total darkness and half of the street cars were taken off as the result of the shortage of coal.

COMMERCIAL PACIFIC CABLE.—The Pacific Commercial Cable Company has ignored the President's stipulation in regard to laying of the Pacific cable, and is going ahead in association with the British Cable Trust.

TELEPHONES FOR TRAIN WRECKS.—The Pennsylvania Railroad Company has placed a complete telephone outfit on many of its wrecking trains, and it is the intention of the company to equip all its trains with such instruments.

EXHIBITION AT ATHENS.—Greece is to have an International Exposition of Industry, Commerce, Art and Hygiene in 1903, beginning April 7, and it will include electrical apparatus of all kinds. American goods are in favor, and could be shown to advantage. Direct boats are now running between New York and Piræus.

PACIFIC CABLE CONFERENCE.—Clarence Mackay, president of the Commercial Cable Company; George G. Ward, vice-president and the general counsel of the company, have asked for a conference with Attorney-General Knox, at Washington, on the subject of the proposed Pacific cable. An appointment will be made for a date after November 16.

EXHIBITION AT JOHANNESBURG.—An international peace exhibition is proposed for Johannesburg, South Africa, in 1904-5, when that large market is expected again to reach a point of great consumption of manufactured goods. The exhibition will include several classes of electrical apparatus, machinery, prime movers, automobiles, etc.

SWEDISH ELECTRIC RAILWAY SCHEME.—The Swedish Government has decided to convert the 4,200 miles of government owned railway into electric traction systems for the purpose of utilizing the natural water power of the country. Representatives of the government were lately in London conferring with American experts. The work will be completed in three years.

PROF. J. J. THOMSON.—At New Haven, Conn., on November 10, at a meeting of the Yale Corporation, the important post of Silliman lecturer at Yale was filled for the first time by the appointment of Joseph J. Thomson, professor of experimental physics at Cambridge University, England. Prof. Thomson is regarded as one of the leading physicists in England. The lectureship is on an endowment of $85,000, left to Yale by the estate of the late Benjamin Silliman, of New York City.

STOCK TICKER DISPUTES.—A special dispatch from Minneapolis, of November 3, says: When the Chamber of Commerce took possession of its new building this morning the announcement was made that the Western Union Telegraph Company had been ruled off the floor entirely. This action was taken in consequence of the Western Union's refusal to sign a new lease increasing the annual rental. The Chamber officials declared the Western Union would never be allowed on the floor until it had come to terms.

ENGINE BUILDERS' ASSOCIATION.—The annual meeting of the Engine Builders' Association of the United States will be held at Sherry's, Forty-fourth Street and Fifth Avenue, New York, Monday and Tuesday, December 1st and 2d. Open meeting for the reading of papers is to be held Monday afternoon at 2 P. M., and several interesting papers have been prepared. Executive meeting for members, 10 A. M., Tuesday, and annual dinner at 8 P. M. of same day. Mr. D. N. McBrier, of Erie, Pa., is the secretary of the association.

TRIALS AT ZOSSEN.—A cable dispatch, of November 8, from Berlin, with reference to the 10,000-volt locomotive, illustrated and described in these columns last week, says: Electrical experiments on the Zossen-Berlin military railroad, which have been in progress for several weeks, have resulted in demonstrating that a speed of 75 miles an hour can be maintained without destructive wear of motors or roadbed. The experiments of 1901, while reaching a speed of 100 miles an hour, proved that running above the rate of 60 miles caused damage to the inadequate roadbed.

BRITISH WORKMEN are here to study American manufacturing plants and accumulate information which may be useful to British concerns. The New York Central Railroad has offered free transportation to the delegates, and the offer has been accepted. Two members of the delegation who come to New York will start for Buffalo on Thursday morning, but will stop off at Schenectady to inspect the General Electric Works. They will be at Niagara on Friday, where they will be joined by the party from Montreal. They will inspect the electrical plant at Niagara, and from Buffalo they will go to Cleveland.

YERKES AND MORGAN.—The "tube" situation in London is discussed as follows by a special cable, of November 8: The quarrel between Morgan and Yerkes has resulted in throwing the whole subject of London's underground rapid transit again into the melting-pot. Those financiers have lost their opportunity, and when the problem is next tackled their profits, if they are concerned at all, certainly will be greatly reduced. The Government will now appoint an expert commission to look into the matter, which will be treated as a whole by adopting a general scheme to which whoever undertakes the enterprise will be bound down by Parliament. The enormous profits on which the Morgan and Yerkes groups were figuring have brought into the field other competitors for the franchises, and there is a proposition now that the big railway companies having terminals in London combine to finance the undertaking in order to keep American capitalists out of English railway enterprises. The Morgan firm, which is thought to have a big "pull" through the great personal influence in the highest ministerial circles of the English partner, Clinton Dawkins, declines to join in the public controversy, but Mr. Yerkes gives interviews freely, in which he welcomes the establishing of some public body to control the general "tube" system, but he objects to intrusting that duty to the London County Council.

AN APPRECIATION OF DR. PUPIN.—A very fine and striking full-page portrait of Dr. M. I. Pupin appears as a frontispiece of last week's *Harper's Weekly*. A sketch of his work is also given, closing with this paragraph: "Professor Pupin is just 44. He is Hungarian by birth, an American from his 16th year. He is an admirable example of the boy who had spunk enough to run away from school. He worked in shops to get money enough to put him through Columbia at 25. He went over to old Cambridge, in England, the home of great mathematicians, to study; there he won the John Tyndall fellowship (the first American who ever did), and with this money he betook himself to Berlin, to study under the Olympian-brained Helmholtz. He wanted to teach physical chemistry. When he got back, in 1889, Americans had not heard of this wonderful science (few have yet). He got a post teaching electricity at Columbia, and there he is still. He created the fine laboratory over which he presides, often out of his own pocket. Evidently, though, his pluck and persistence paid, for he is rich now—famous as well. He is a fine type for imitation. If a plaster cast of him, with this little account of him stencilled underneath, were in every school-room in the country, it might stimulate other clever American boys, imported or native, to run away from school and learn to do things that are worth while."

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION will hold another meeting at the Auditorium Hotel, Chicago, December 9, 10 and 11, when a full programme of entertainment and work is being laid out.

CHICAGO ELECTRICAL ASSOCIATION.—Mr. Howard Brooks, electrical engineer of the Aurora, Elgin and Chicago Railway, will read a paper before the Chicago Electrical Association on November 21, on the electrical features of that important road.

ART AND ELECTRICITY.—An important competition just held by the Brussels Municipal Art Association was devoted to artistic public fountains, electric car waiting rooms, slabs for street names, newspaper "kiosks," electric car poles and electric clocks, advertising signs and artistic house façades. The electric car line poles on exhibition were all of them very graceful creations of the iron founder's art, and a great improvement on the poles so generally used in other countries.

ATLANTIC WIRELESS MESSAGES.—A cable dispatch from Rome, of November 11, says: "The Ministry of Marine has received a dispatch from the captain of the Italian cruiser, "Carlos Alberto," which was placed at the disposal of Signor Marconi for wireless telegraph experiments, and which is now at Sydney, Nova Scotia, stating that the ship daily communicated, by means of the Marconi system, with the station at Poldhu, Cornwall, England, throughout the voyage and after entering the port of Sydney. The experiments confirmed the possibility of communicating simultaneously with Europe and America, during the navigation of the Atlantic, at a distance of at least 3,000 miles. It will be easier to assure communication when instruments more powerful than those that can be carried on ships are installed at shore stations."

"THE ENGINEERING RECORD" through the retirement from active business life of its publisher, Mr. Henry C. Meyer, has passed into the hands of the McGraw Publishing Company, who will continue it along familiar lines, and will seek to enhance its admitted usefulness as a leading journal in the field of civil and industrial engineering. Mr. Meyer has, however, consented to give the publication the benefit of his experience in an advisory editorial capacity, so that the readers of the *Record* will still enjoy the experience and sound judgment that have won for Mr. Meyer so high and honorable a place in technical journalism. With an entire absence of the sensational in his methods, Mr. Meyer has created and built up a paper of the best standing and reputation, and his work of the past quarter century affords a splendid foundation for the development he has himself rendered possible.

THE NEW SUBMARINE BOATS.—A dispatch from Washington states that the contractors have notified the Navy Department that two submarine boats will be ready for their official trials this week, and that the trials will begin as soon afterward as the trial board is ready. Many improvements have been made in the new boats over the "Holland," the only submarine boat the navy possesses, and the trials are calculated to demonstrate the superiority of the "Adder" and "Moccasin." The new vessels are 63 feet 4 inches in length, compared to 53 feet 10 inches for the "Holland." In diameter they are 11 feet 9 inches, against 10 feet 3 inches, and they have a displacement of 122 tons submerged, against 74 tons for the "Holland." The latter vessel makes six knots on the surface and 5½ submerged, with a gas engine of 50 hp for surface running, and a 50-hp electric motor for propulsion when submerged. The new vessels will have gas engines of 160-hp, and an electric motor of 70-hp, while its batteries will have a capacity of 1,940 amp.-hours, more than double the "Holland" batteries. Three Whitehead torpedoes are carried by the "Holland," and five by the "Moccasin" and "Adder."

MARCONI AT GLACE BAY.—In an interview with a representative of a New York daily newspaper, Mr. Marconi, after his arrival at Glace Bay, N. S., on the Italian cruiser "Carlo Alberto," said: "I conducted experiments all the way across, and met with very good results, especially in transmitting and receiving messages between the cruiser and the Poldhu station. We were in constant communication with the station for about 200 miles, which was as far as the strength of the instruments on board the warship would stand. Messages had been received at a much greater distance, however.." Heavy gales were encountered during the voyage, but they did not affect the transmission of messages. Mr. Marconi stated that the wireless telegraph system would be cheaper and easier in operation than the cable system, the expense being only about 10 per cent. of that of laying cables. At present he was trying not for speed, but for the completion and perfection of the system. There are now, he said, 30 or 35 stations situated in all parts of the world—England, Italy, Holland, Germany and America, the Congo and in the Dutch East Indies. In cluding the ships, there were 70 in all. Seventeen ships were equipped for commercial purposes and 12 land stations.

COMPOUNDING ALTERNATORS.—Two patents issued November 4 to Charles P. Steinmetz relate to a method for compounding single or polyphase alternators whereby the excitation of the generator is increased with increased load or lagging current, and decreased with diminished load or leading current. To accomplish this a current derived, as will later be described, is supplied to the alternating-current side of a rotary converter, from the direct-current side of which the exciting current is drawn. To illustrate—by the application of the method to a single-phase alternator, in series with one of the alternator main leads is the primary of a transformer, the secondary of which is connected at one end to a separate generator winding, the other end of the latter being connected to a collector ring; the other end of the secondary is connected to a second collector ring, the brushes of the two rings being connected with the rotary converter. By the use of a reactive coil (known also as an auto-converter) the auxiliary generator winding may be dispensed with. In this case a portion of the winding of the reactive coil is in series with one of the mains, the end of the other portion being tapped to an intermediate point of the armature winding, the primary of the transformer in them in the circuit between the top and reactive coil. By the composition of the two e. m. fs. thus obtained in the compensating circuit—one the main and the other an auxiliary e. m. f.—a resultant exciting e. m. f. is secured, which will tend to increase in value with lagging currents and to decrease with leading currents, and changing both with the load and with the phase displacement, which renders possible in practice the desired regulation.

ROTARY CONVERTER REGULATION.—Two patents, issued November 4, have for their object to compensate for the armature reaction of inverted rotary converters, the means described anticipating the variation in speed, which otherwise would result from a change in field strength, due to the reaction of wattless current in the armature upon the field. The arrangement consists in the employment of a regulating direct-current machine, driven synchronously with the inverted converter to be regulated, and operating to supply an e. m. f. directly proportional to the amount of wattless alternating current in the mains. The armature of this machine is provided with two distinct windings, and in structure resembles somewhat a motor generator. One of the windings is of the usual kind and connected to a commutator, the brushes of which are connected to the shunt field of the machine, and to the converter field winding, the latter being also connected to the direct-current mains. The second winding is arranged in series with the alternating-current mains by means of collector rings, and is also connected to the converter alternating-current leads. When the wattless current in the latter winding varies, its reaction upon the field of the regulating machines alters the field strength, and consequently the exciting e. m. f. derived from the first-mentioned winding. Two patents, issued on the same date to Ernst J. Berg, deal also with the regulation of converters. The method consists in varying the reactance of the alternating-current system by means of a variable inductance, which is of the ring-core type, resembling an induction motor. The movable portion is automatically adjusted at different angles by means of a solenoid connected in series in the direct-current circuit. An increase, for example, of current in the direct-current circuit would tend to cause its e. m. f. to drop, but such tendency is counteracted by a partial rotation under the influence of the solenoid of the movable member of the inductance, which reduces the inductance in series with the alternating-current side of the converter, and thereby increasing the e. m. f. on the direct-current side.

LETTER TO THE EDITORS.

College Education.

To the Editors of Electrical World and Engineer:

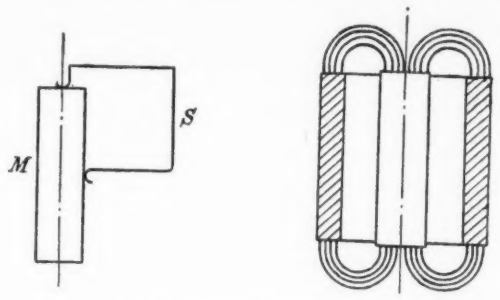
Sirs.—In am glad to see you, in a recent issue of your publication, holding up for the high standard of the American college. It does seem to me to be illogical and foolish for our colleges to lessen the number of years required for graduation. Speaking from experience, I am satisfied that I was poorly enough qualified at the end of four years for post-graduate study, although I was possibly as bright as the average. What seems to be the tendency of the college toward contraction in curriculum is, I believe, only a spurt. Within the second decade of its experience we shall see the climax of the aberration, and the true American college cycling back into line. The prodigal will return to his father's house of his own accord, and the elder brother will frown, but the household will rejoice. Americans have made rapid and substantial progress in commerce, invention and policy. The college deserves her share of credit for training the men who are in the van of the world's progress. To contract the college course is only to cripple the graduate for the work that lies before him.

STERLING, KANSAS. J. H. ARMSTRONG, B. A.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Unipolar Induction.—CAHEN.—An interesting theoretical article in which he first discusses a recent experiment of Hoppe, which is essentially based upon Faraday's original typical form of a unipolar dynamo. A cylindrical magnet, *M*, which can be revolved around its magnet axle, is connected to an external circuit, *S*, by means of two sliding contacts, as shown in Fig. 1; Hoppe does not use a permanent magnet, but an electromagnet, the magnetizing coil being wound around the lower half of the core *M;* this coil is stationary, while the iron core is revolved. Hoppe wants to show with this apparatus that the total magnetic flux revolves together with the iron core. For this purpose he first revolves the iron core, while the circuit, *S*, is fixed, and find that a direct current is generated in *S*, the e. m. f. of which is proportional to the speed of the iron core. In the second experiment the circuit, *S*, is rigidly fixed to the iron core, so that both revolve with the same angular velocity;



FIGS. 1 AND 2.—UNIPOLAR INDUCTION.

in this case no current is generated in *S*. He shows this as follows: He has a galvanometer in *S*, but as he cannot make this participate in the revolutions, Hoppe inserts in *S* the primary winding of a small transformer which takes part in the revolutions. The ends of the secondary coil lead to two slip rings which slide on fixed brushes connected to the galvanometer. During the experiment, in which only direct current is generated, there is, of course, no deflection of the needle of the galvanometer; if, however, the circuit, *S*, is broken and closed, there is at such moments a deflection of the needle; the experiments show that when the iron core alone is revolved, direct current flows through *S*; if iron core and *S* revolve together, there is no current. Hoppe draws the conclusion that the seat of the induced e. m. f. must be in *S*, caused by the magnetic flux revolving with the iron core and cutting *S*, for as there is no current in the revolving *S*, the increase of the e. m. f. produced when *S* is stationary must be due to its being stationary, and must have its seat in *S*. The present author says that this conclusion is not justified; the fact that there is no current in *S* in the second experiment may be due to either of the following two causes: Either in the first experiment an e. m. f. is produced which does not exist in the second, or in the second experiment an e. m. f. is produced which is equal and opposite to that in the first. The experiment does not and can not prove in any way which of these two possibilities is a fact. The author then gives some theoretical considerations which prove that the total e. m. f. induced in the total closed circuit, *S*, is proportional to the relative speed of the iron core with relation to *S*, and entirely independent of the speed of rotation of the magnetic flux. This shows conclusively that an arrangement of the kind as described above cannot decide anything concerning the question whether the magnetic flux rotates with the same speed as the iron of the magnet or not. The author then develops a theory which is fundamentally based upon the conception of a "resistance," with which a medium opposes the motion of a magnetic flux. This resistance may be of a double nature. The one purely magnetic, is similar to the mechanical friction resistance; if two magnets attract one another, this is due to the action of the magnetic fluxes; this conception supposes that the fluxes are fixed with a certain force in the magnet—in other words, a certain resistance to this displacement. The resistance of the second kind is that with which a closed circuit opposes the motion of a flux, because an e. m. f. is induced in it which produces a current which tends to counteract the motion of the flux; this second kind of resistance may be considered as a molecular friction between matter and fluxes. The author points out that there is nothing unnatural in the conception of a magnetic flux which is to a degree independent of its magnetic mass, and can move with a speed different from that of its mass.

This is clearly indicated by the following arrangement, shown in Fig. 2. In a hollow cylindrical permanent magnet there is in the central part a solid cylindrical permanent magnet; both are capable of revolving around their common vertical axle; the upper pole of the external hollow magnet and the upper pole of the internal solid magnet have opposite signs, as have also the lower poles, then the lines of the magnetic fluxes have a form indicated in the figure; now, if one of these two magnets is revolved around the axle, while the other is held stationary, it is evident that the lines of magnetic flux must get a relative motion at least against one of the two magnets; here it is supposed that the total magnetic flux is a unit, which is self-evident from the point of view of physical science. He then gives theoretical considerations on the movement of the magnetic flux if two magnets are moved relatively to each other. He gives a mechanical analogy of the induction phenomena between two electric circuits; he compares these two circuits with two solid bodies moving in an electric medium which opposes this movement with a certain resistance; when this resistance is overcome, heat is developed equivalent to the work performed by friction; besides this heat, a part of the work is used up in deforming the elastic medium, and is stored up in the form of potential energy (analogous to self-induction). In the relative solution of solid and fluid bodies under the influence of friction forces, the total developed friction heat is a minimum. There is an exactly analogous rule for the electromagnetic phenomenon: the induction in moved conductors always takes place in such a way that the total change of electrical energy into heat is a minimum. He applies this to the phenomenon of magnetic friction, as defined above, and states that the motion of the magnetic flux is always so that the total "friction work" is a minimum; friction work is meant here in the most general sense, and comprises the electric as well as the magnetic friction work. This rule is now applied by the author to the arrangement shown in Fig. 1. He had shown before that the speed of the flux has no influence upon the induced e. m. f. and current, both of which depend

only upon the relative motion between iron core and circuit *S*. If this statement is taken together with the rule just developed, it follows at once that the flux does not move relatively to the magnet. For the total heat, produced during the movement, is the sum of the Joulean heat and the hysteresis heat; the former is independent of the movement of the flux, while the latter is proportional to it; hence the total heat is a minimum if the magnetic friction heat is zero, *i. e.*, if the magnetic flux does not move relatively to the iron core. He applies his principles to a discussion of the problem whether a self-exciting dynamo without iron would operate, even if current is started by other means, *i. e.*, one which is based solely upon the dynamometric principle, consisting of a system of stationary coils generating the field and a system of moving coils connected to a commutator; from the principle of the minimum of friction work it follows that such a dynamo is impossible. The author believes that this principle of the minimum of friction work is only a special case of a very general law, another special case of which is the rule that the distribution of the currents in a network takes place in such a way that the total current heat is a minimum, from which the second rule of Kirchoff on the distribution of currents in branched circuits results.—*Elek. Zeit.*, October 16.

REFERENCE.

Commutation.—Freund.—A communication referring to the recent article of Rothert, and giving some mathematical calculations in connection with Rothert's fundamental differential equation.—*Elek. Zeit.*, October 16.

Power.

Electric Power in Iron and Steel Industries.—Selby-Bigge.—A paper read before the (Brit.) Iron and Steel Institute. He gives a number of statistical data on the savings effected in actual working by the substitution of electric power for steam for power purposes in iron and steel plants, also on the cost of the electric power for such purposes in actual plants. The greatest economy results in the substitution of electricity for steam in those cases where the units of power, both in engines and boilers, are most subdivided. There are enormous advantages to be derived, especially in the case of intermittently working machinery, where the load is of a very variable nature, and particularly so in all crane work. He then gives a long table giving a complete schedule of tests made to determine the horse-power of motors adapted for the driving of various classes of machinery and of machine tools. He also refers briefly to the utilization of waste blast-furnace gases.—Lond. *Elec.*, October 3, 17.

Three-Phase Pumping Plant.—Perkins.—An illustrated description of a three-phase pumping installation at Dortmund, Germany. The actual work required is the lifting of 5 cubic meters of water per minute from a depth of 300 meters, but the plant installed is capable of raising this amount of water 400 meters. The pump operates about five hours a day to carry off the flow of one cubic meter per minute in the shaft. The pump is driven by a large three-phase induction motor, which operates at a speed of 75 r. p. m., and with a maximum starting torque it develops 570 hp, which is about 20 per cent. higher than the normal torque. The total weight of the motor is 30,000 kg., that of the rotating portion being 11,000 kg.—*West. Elec.*, November 1.

REFERENCE.

Electricity in Iron and Steel Plants.—Kylberg.—The first part of an abstract of a paper read before the (Brit.) Iron and Steel Institute. He thinks it is probable that at no distant date both auxiliary steam engines and hydraulic power in iron and steel works will be entirely superseded by electrical power. He refers to the development of the blast furnace gas engine, and describes some developments based on American experience and adapted to European requirements. He first discusses gas-driven engines for generating electricity in central stations, and then deals with electrically-driven ore transporting arrangements beneath the ore bins and the electric blast furnace charger, and describes an electrically-driven pig-iron casting machine.—Lond. *Elec.*, October 17.

Traction.

Electric Traction in its Relation to Existing Railways.—Jacomb-Hood.—An abstract of a paper, in which he shows that the present railway practice on branch lines does not provide the facilities which the growing demands of the public require. There should be more and smaller trains at more frequent intervals; there should be self-propelled cars, or trains of cars of which a large number are self-propelled, to secure economy of propelling power proportionate to the length or weight of any train. Then there should be higher acceleration and quick retardation, to reduce the total time of a trip. He then discusses the question of cost and takes as an example his own railway; to make the change profitable, an increase of traffic is necessary; from the figures given by him, such an increase appears probable. If such a rapid transit scheme should come into operation, freight service would have to be performed at night, with the aid of electric locomotives.—Lond. *Elec.*, October 17.

Economical Methods for Removing Snow.—Danforth.—An article on the conditions in Rochester, where the snowfalls in winter are extremely heavy. The company finds it impossible to keep its tracks clear without a rotary snow plow, but for light snows the rotary plow is as undesirable as a rattan sweeper would be in 2-foot of snow. The practice is to start out the light plows and sweepers when there is no more than 2 inches, then the heavy shear plows, then the extension plows are used to level off the ridges and shovellers are sent to clean the cross walks. The work of the rotary plow commences when the banks of snow on either side of the tracks become so high that the shear plows can no longer shove them back. The cost of removing ice and snow last year in Rochester was about $90 per mile of track.—*St. R'y Jour.*, September 20, and *Int. Ed.* October.

REFERENCES.

10,000-*volt, Three-Phase Locomotive.*—A long, illustrated translation in abstract of the paper of Reichel, recently noticed in the Digest.—Lond. *Elec. Rev.*, October 17. (See Electrical World and Engineer, November 8.)

Tests of Interurban Cars.—Renshaw.—An account of tests made by him for the Westinghouse Company, on the system of the Union Traction Company, of Indiana. This company owns about 100 miles of interurban track and about 65 miles of city track, and is now building about 130 miles of track. Fifteen cars are required for the ordinary service. There is one power station from which power is distributed at 16,000 volts. The cars have bodies about 40 feet in length, and weigh, complete, about 63,100 lbs., without passengers. Each car is equipped with two 150-hp, or four 60-hp motors. The tests were made of cars in local service, also in express service. The local-service tests are reproduced in the large engravings. The results of the tests in kilowatt hours per ton-mile for different characters of run are given. Other features discussed are the average current consumption, average voltage, tests on braking and tests with four-motor car equipments.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Test on Energy Consumption of Interurban Cars Around Detroit.—Two diagrams giving the results of two tests, both made between Detroit and Flint, a distance of 100 miles, one being for a complete round trip, the other for the run from Flint to Detroit. The results are tabulated.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Car Dispatching in Interurban Lines.—Mitten.—A discussion of the practice on a line about 40 miles in length, which distance is covered in 2¼ hours. The rules governing the motorman, conductor and dispatcher are given very fully.—*St. R'y Jour.*, September 20, and *Int. Ed.*, October.

Economical Management of Repair Shops.—Banghart.—An article giving a list of the tools and other equipment desirable for the repair shops of a line operating from 75 to 100 cars, and describing an arrangement of the equipment in the different departments; it also states the number of men required for the proper inspection of the different parts of the equipment.—*St. R'y Jour.*, September 20 and *Int. Ed.*, October.

Installations, Systems and Appliances.

Cut-Out.—An illustrated description of the Ferranti electrostatic voltmeter cut-out for protecting high-tension electrostatic voltmeters. This resistance cut-out is used in the new Midland power distribution system, and appears to answer all requirements in connection with underground mains. It consists of a small glass tube filled with water of a certain conductivity. A small valve is made in the glass tube near the bottom, consisting of a hole covered with a piece of rubber tubing, somewhat similar to the rubber valve of a bicycle tire. The current is led in at the top and bottom of the glass tube by means of platinum wires fused into the sides of the tube. These are connected to the outside to brass terminals, and the whole is enclosed in an outer porcelain case with plugs which fit into the terminals underneath the voltmeter. Should a spark occur for any reason, such as a short-circuit inside the instrument, the water inside the glass tube will vaporize and force itself out through the valve, thus safely breaking the circuit. The resistance of the water

is extremely great; it is so adjusted as to be only low enough to allow sufficient current to flow through to boil the water. This arrangement has been subjected to very severe tests, such as placing it directly across the terminals of a 3,000-volt alternator; in this case the circuit was broken so quickly that the tube had to be carefully examined to see whether it had blown or not.—Lond. *Elec.*, October 24.

Practical Operation of Rotary Converters.—SALTER.—An illustrated article on a plant containing two 500-kw direct-current compound-wound dynamos, one 5,000-volt, 25-cycle, three-phase, double-current generator, which is either used for running as a direct-current generator in parallel with one of the direct-current dynamos, being driven by the three-phase alternator, or it is used for generating alternating current in the event of the alternator being shut down, and, furthermore, for running in parallel with the alternator at times of excessive load on the substation; this arrangement works very satisfactorily. Some notes are given on starting the converter. The method used for overcoming the instability in the speed of the rotary when driven as a direct-current motor is to excite the rotary by means of a small generator, which is driven from the rotary itself. Tappings are taken from the three-phase side of the rotary to a small induction motor, which is directly connected to a small continuous-current generator; this generator works low down on the characteristic curve, and is unsaturated at the normal e. m. f. Any change in the speed of the rotary, therefore, causes a much greater change in the e. m. f. of the exciter, and this varies the field of the rotary and keeps the alternations constant independently of the nature or amount of the load.—Lond. *Elec. Rev.*, October 17.

ELECTRO-PHYSICS AND MAGNETISM.

Resistance of Metallic Sulphides.—VAN AUBEL.—An account of experiments to find the change of electric resistance with decreasing temperatures. It is known from the researches of Dewar and Fleming and d'Arsonval that the resistivity of pure metals and of alloys diminishes considerably as their temperature approaches the absolute zero; according to the theory of electrons it means that the number of free electrons increases enormously as the heat vibrations diminish in amplitude. The case is just the reverse in chemical compounds, as is shown by the present author. He measured the resistance of a prism of iron pyrites, 1 cm. long and 4 mm. square in cross section; in this case the resistance, instead of tending towards zero as the temperature falls, tends towards infinity; this would mean that whatever free electrons exist in the sulphide at the ordinary temperature, tend to disappear entirely as the excursions of the molecules are reduced to a smaller amplitude.—*Comptes Rendus*, September 15; abstracted in Lond. *Elec.*, October 17.

Flames in Alternating Fields.—DE ROSSI AND STELLA.—A description of some experiments on the behavior of a flame in an alternating electrostatic field. Two insulated metallic discs are placed vertically and parallel to each other, and are connected with the secondary of an induction coil, the primary of which is supplied with an alternating current. A flame is placed in the space between the two discs; it is earthed through a galvanometer. In the first series of experiments the flame was displaced along the space between the discs and the current determined in the different positions; it was found to diminish very rapidly towards the center between the two plates, but the sign of the current differed greatly according to the substance burnt. A positive current was obtained with benzine, amyl acetate, illuminating gas, alcohol, acetylene, methane, cyanozen, stearine, camphor and paraffine, a negative current by phosphorus and possibly sulphur, and no current at all by flames of hydrogen, sulphuretted hydrogen, carbon bisulphide and carbonic oxide. When the flame is long and thin, it apparently spreads out into a fan when the field is excited, but when it is then examined by means of a revolving mirror, it is seen that this appearance is due to a superposition of images, the flame following every alternation of the field by bending aside.—*Nuovo Cimento*, August; abstracted in Lond. *Elec.*, October 17.

REFERENCES.

Discharge of a Condenser.—MARCHANT.—An illustrated British Association paper, in which he describes a graphical method of determining the discharge of a condenser through a variable self-induction. It is an extension of a method of Sumpner for determining the rise of current in a circuit with a variable self-induction, to which a potential difference is suddenly applied.—Lond. *Elec. Rev.*, Oct. 17.

Magnetostriction.—HONDA AND SHIMIZU.—An account of an investigation of the influence of tension upon the Wiedemann effect in nickel, steel, iron and cobalt.—*Phys. Zeit.*, September 15; abstracted in Lond. *Elec.*, October 17.

ELECTRO-CHEMISTRY AND BATTERIES.

The Prospects for a Light Storage Battery.—NORDEN.—He believes that the lead accumulator has been so much improved in recent years that there is little room for further development. The "light accumulator of the future," he thinks, must be a non-lead accumulator. He then discusses past trials with metals other than lead. The zinc lead peroxide cell has a higher ampere-hour capacity per lb. of weight, and its discharge voltage is higher by 25 per cent.; but the disadvantage is that during discharge the zinc goes into solution and during charge it is not so perfectly and cleanly redeposited, but is often spongy in form, causing short-circuits; local action at the zinc plate and other troubles cannot be entirely avoided, in spite of amalgamation. These disadvantages apply generally to any soluble electrode; he, therefore, claims as a principle that a soluble electrode is unsuitable for a storage battery. In the cuprous oxide, zinc accumulator, there is the same trouble with the zinc, and the copper plate also has disadvantages, as the cupric oxide goes into solution and copper is then deposited on the zinc, causing a fatal local action. Metals like zinc are never deposited upon the opposite plate; he, therefore, claims as a second principle that two different metals in an accumulator are practical only if they are either both insoluble in the electrolyte or when dissolved cannot be deposited on the opposite plates. He considers the Edison accumulator a step in the right direction, although he does not think that it represents the definite solution of the problem of the light accumulator. The mechanical construction which the active material compressed in perforated boxes is not the best construction for utilizing the total active mass, as the entering of the current into the interor of the boxes and the diffusion of the electrolyte into the pores is somewhat difficult. The capacity of the Edison cell per lb. is too much like that of the lead cell. A new principle has not been found in the invention of the Edison accumulator. He finally points out the impossibility of predicting anything on the probable future development from a purely theoretical point of view.—*Centralblatt f. Accum.*, August 15.

Graphite.—DANNEEL.—An account of an investigation by Borchers and Moegenburg, on the conversion of amorphous carbon into graphite in the electric furnace. If absolutely pure carbon is used, the conversion is very difficult, but the conversion is greatly accelerated if metals or metallic compounds are present which are able to form dissociable carbides. They have found that aluminum is the most convenient and effective material, the quantities required being relatively small.—*Zeit. f. Elektrochemie*, September 25.

Electric Double Layer and Absolute Potential.—BILLITZER.—A Bunsen Society paper, in which he describes a method devised to determine the absolute value of a potential difference between an electrode and electrolyte. In the discussion it was pointed out that Helmholtz, Oswald and Billitzer had devised methods which give very different results, thus leaving the whole problem in doubt. Nernst proposed to consider the whole matter as hypothetical, and to use a convenient, although arbitrary, zero point by assuming the potential difference at the hydrgen electrode to be equal to zero. *Zeit. f. Elektrochemie*, August 28.

REFERENCES.

Electrolysis of Alkaline Chlorides.—FOERSTER AND MUELLER.—A long account of a series of experiments with solutions of alkali hydrate, hypochlorite and chloride, electrolyzed with increasing voltage.—*Zeit. f. Elektrochemie*, August 28, September 4.

Manufacture of Aluminum.—HABER.—A Bunsen Society paper, in which he describes a series of experiments in which he tried to show on a small scale the principal points which are important for the success of the manufacture on a large scale.—*Zeit. f. Elektrochemie*, August 21.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Aluminum Foil Electrometer.—GRIMSEHL.—A description of an aluminum foil electrometer possessing certain decided advantages over the types hitherto used. The rod bearing the aluminum foil also bears a vertical plate of aluminum, against which the foil rests when the electrometer is uncharged. Another piece of aluminum foil, considerably thicker than that used for the index, is mounted

in a separate horizontal axis, and can be made to lie flat against the index foil in its zero position. This arrangement ensures portability. It also greatly increases the sensitiveness of the apparatus. If very small e. m. fs. are to be discovered, the movable thick foil or cover is brought closer to the fixed piece. Another improvement is the stopper, which is made in two pieces, each of which will independently hold the index in position while the other is being cleaned. Ebonite acquires a certain conductivity under the influence of light and dust; this is gotten rid of by a vigorous application of soap and water. The best arrangement is to keep a spare stopper in a light-tight box. It can be exchanged without removing the index. The high sensitiveness of the apparatus (2 volts) is due to the fact that aluminum foil, 90 mm. long, is used.—*Phys. Zeit.*, September 15; abstracted in Lond. *Elec.*, October 17.

Alternating-Current Meter.—STERN.—A long, illustrated article, in which he says that while the Union Electric Company, of Berlin, has up to the present time built only meters of the Thomson type, they have now put on the market an alternating-current meter of the induction type (Ferraris). It is distinguished from all other meters of the same type by the feature that it has two parallel aluminum discs mounted on the axle. Between them there are three electromagnets, side by side, the two outer ones being supplied with the main current, while the middle one is magnetized by the shunt current. The coils of the two outer ones, through which the same current flows, are oppositely wound, so that the upper ends of both have opposite polarities. For the middle electromagnet, a short-circuiting magnetic circuit is supplied, so that its lines of force pass through the aluminum discs perpendicularly to them. The lines of force from the outer magnets are perpendicular to the lines of force of the middle magnet. The theory of the meter is given at length and its construction is described.—*Elek. Zeit.*, August 28.

REFERENCE.

Standard Cells.—COHEN.—A German Bunsen Society paper on the changes of the cadmium amalgam in Weston cells under certain conditions; also on the electromotive behavior of cadmium amalgams.—*Zeit. f. Elektrochemie*, August 28.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Wireless Telegraphy.—SOLARI.—An illustrated report, supplementary to the one in the ELECTRICAL WORLD AND ENGINEER, October 25, on an extended series of tests of long-distance wireless telegraph transmission from Marconi's powerful station at Poldhu, Cornwall, England, to the Italian cruiser "Carlo Alberto," while the latter sailed through the North Sea and Baltic Sea to St. Petersburg and back to England, and finally returned through the Atlantic Ocean and the Mediterranean Sea to Italy. Marconi's magnetic wave detectors were used, and the results were very satisfactory, even over distances of 1,200 kw (750 miles). A complete record of the tests is given, and some of the records of signals recorded on the tape of an ordinary Morse machine are reproduced. The author sums up the results as follows: There is no limit to the distance to which electric waves can be sent over the surface of the globe as long "as the energy of transmission is proportional to the distance to be covered." The land interposed between the transmitting and receiving stations does not interrupt this communication. Sunlight has the effect of diminishing the area covered by electric waves, and, therefore, makes necessary the employment of greater amounts of energy at daytime than at night time. The influence of atmospheric discharges makes it necessary to diminish the sensitiveness of the apparatus in order to make the latter independent of them; at the same time the energy of transmission must be increased to compensate for the loss of sensitiveness. The efficiency of the magnetic detector has been shown by these positive experiments to be superior to that of any coherer, and this not only because it requires no regulation, but also on account of the absolute constancy of working, as well as the immense sensitiveness and practical value of the system. "Wireless telegraphy, according to Marconi's system, has, owing to the latest advances, entered into the field of the greatest practical applications, whether commercial or military, and without limit of distance."—Lond. *Elec.*, October 24.

Some critical editorial notes on this report, which is conceded to be undisputed evidence that wireless telegraphy has been carried on unidirectionally over a distance of 1,200 km (1,750 miles), with both land and sea intervening. It is said, however, that the report also shows that "these long-distance feats are tantalizing in their uncertainty. Messages might be received on one day and the next day, for no apparent reason, might fail to have any accurate effect on the receiving apparatus. . . . We have reason to know that these very signals transmitted from the Poldhu station were read in more than one place in England with instruments not tuned by the Marconi Company for the purpose—in fact, by instruments not in the possession of the Marconi Company at all. Thus, not only is there a lack of secrecy in the messages transmitted from the Poldhu station, but the great energy of the radiations emitted is sufficient to disturb other and independent apparatus." It is thought that long-distance experiments are useless for practical purposes.—Lond. *Elec.*, October 24.

Wireless Telegraphy.—COLLINS.—An illustrated description of the De Forest system.—*Elec. Rev.*, October 25.

MISCELLANEOUS.

Manchester Technical School.—An article on the new municipal technical school of Manchester. The electric power plant contains five machines, four of 100-kw each, and one of 50-kw, the latter is a Parsons turbo-electric generator; with the purpose in view of affording facilities for research and experimental work, it was decided to have representative engines and dynamos of five different types, so that comparisons might be drawn and deductions made. There is also a storage battery of 600-amp.-hours capacity. One of the most important departments in the school is that of electrical engineering and technical physics; no fewer than 20 rooms have been entirely given up to it, including a photometer room, 60 feet in length. In this room are photometers of the Lummer-Brodhun, Steinheil and Kruess types, together with pentane, amyl-acetate (Hefner), Methven and Carcel standards; there is also a Letheby-Bunsen double-standard photometer; special photometers for arc and incandescent lamps, as well as certified English, French and German standards of light, will be provided; among the optical apparatus there will be a grating spectrum apparatus. In the electrical engineering laboratory special arrangements and instruments have been provided for the testing of all kinds of electrical plant, both continuous and alternating, and an experimental railway truck has been installed in the dynamo room; it is so constructed that a complete series of tests can be carried out under conditions approximating those obtained in actual working. Below the apparatus there is a pit; friction wheels carry the truck, and the mechanism is coupled to a large flywheel, the mass of which can be altered, it being built in segments for the purpose. The load may be varied by regulating the amount of water contained by four tanks carried on the car frames. A great variety of tests may be made, as the truck is fitted with controllers and motors, complete, while "a motor fixed outside supplies the necessary acceleration factor due to a down grade." A great number of machines have been installed for testing purposes. There is also a testing room, fitted with Addenbrooke's electrostatic instruments, for making commercial tests of generators and motors.—Lond. *Elec.*, October 17.

Magnetic Concentration.—HASSREIDTER.—A description of the Mechernich system of magnetic concentration. The ore passes through a chute between two magnetic poles, the upper, north, one of which is rotated, attracting the magnetic particles which are carried around by it into zones of progressively diminishing intensity until the centrifugal force imparted to the particles overcomes the magnetic attraction and they fall, being classified according to their magnetic properties. This arrangement is claimed to have the advantages of dispensing with belt carriers, and of enabling one to use small magnetic fields with very narrow air gaps, thus minimizing the loss of energy and making it possible to attract feebly magnetic particles by a very weak current. In separating blende and siderite from the Upper Harz, the grains being of 0.5 mm. size, 98.7 per cent. of the zinc has been recovered. With dolomitic Silesian blende of 2 to 3 mm. size, the recovery was 91.8 per cent., which was increased to 93.5 per cent. by reducing the grains to 2 mm. In treating ore from Broken Hill, a yield of 81 per cent. of the lead and 69 per cent. of the zinc was obtained. A plant of this type installed at Broken Hill, for the treating of middlings assaying 28 per cent. zinc, 10 per cent. lead and 9 ounces silver per ton, furnishes a product with 44 to 45 per cent. zinc and 4.5 per cent. lead.—*Jour. Soc. Chem. Ind.*, September 30; abstracted in *Eng. and Min. Jour.*, November 1.

Photo-Therapeutics.—An account of the discussion held at the Berne congress of "electrology and medical radiology," on the modern methods of applying powerful sources of light, and more especially actinic light, to the treatment of diseases. Foveau pointed out that the "electrolytic anæsthetic and microbicidal action of sunlight" was discovered by an observation of the rarity of lupus in tropical countries and accidental cures by exposure to sunlight. Kurella said that every state should possess a Finsen apparatus. Michaud reported favorably upon Foveau's apparatus with an arc lamp provided with quartz light-filters and a water circulation. Strebel described the various forms of arc lamp in use, and favored the type containing carbons with an internal water circulation. Tonta described an improved light bath, provided with a ventilator and a hygrometer. The apparatus comprises six circuits of eight incandescent lamps each. For producing blue, red or violet rays, colored screens are used. Openings in the walls of the bath enable the physician to feel the pulse and the heart without opening the bath. —*Arch. d'Elec. Med.*, September 15; abstracted in Lond. *Elec.*, October 17.

REFERENCE.

Manufacturing Plant.—An illustrated description of the new plant of the British Thomson-Houston Company, at Rugby.—Lond. *Elec.*, October 24.

New Books.

DAS SELEN UND SEINE BEDEUTUNG FUR DIE ELEKTROTECHNIK. By Ernst Ruhmer. Berlin: Verlag der Administration der Fachzeitschrift "Der Mechaniker." 57 pages, 49 illustrations. Price, 2.40 marks.

Mr. Ernst Ruhmer, who has for a long time been making experiments with the little known element selenium, and who has obtained excellent results by modifications of the older forms of selenium cells, has given in the present pamphlet much matter of general interest.

Selenium is so little known that a rather extended review will perhaps be in order. The material is an element belonging to the sulphur group, and like other members of that group occurs in different forms. The one in which it is primarily obtained ordinarily is the amorphous state in which it is a red powder. If this amorphous selenium is melted it assumes a different form, being then a black shellac-like substance that is so poor a conductor of electricity that it may be ranked among the insulators. If this second form is subjected to a temperature of about 200 degrees, kept there many hours and then slowly cooled the material assumes another state, becoming crystalline and of a gray color. It is this final modification that has the unique property of a decreased electrical resistance when it is exposed to light. Although this form is a conductor it is a poor one, and it is not possible to use it, say, in the form of a rod or plate. Various experimenters have made up selenium resistance elements, or "cells," as they are called, in which this difficulty is overcome by placing two conducting plates or wires close together with the selenium intervening and then winding them up into a compact form.

The author makes his cells by winding parallel to each other about a glass cylinder about ¾ inch diameter and 1¼ inches long, two platinum wires spaced about one thirty-second of an inch apart. The interstices between the wires are filled with the second modification of selenium by melting the amorphous form and pouring it on, and this is then converted into the third modification by being subjected to long continued heating, as above mentioned.

In the earlier form of cells the resistance when exposed to light was anywhere from ¼ to 1-15 of the resistance when in a perfectly dark space; the action of the cell is quite erratic, being subject to great modification by atmospheric conditions.

Mr. Ruhmer places his cell inside of a glass tube from which the air is exhausted and implies that under these conditions it is perfectly stable. The glass tubes have ordinary Edison bases secured to them, and look like "candle" type incandescent lamps. The sensibility of these cells is such that their resistance when exposed to light is only 1-80th of the resistance that they offer when they are in the dark. This increased sensibility is, however, of minor importance compared with the advance that Mr. Ruhmer has made in producing cells which respond quickly to changes in illumination. In the older types, while there was a quick and very large drop in resistance when first exposed to the light, it required several minutes or even hours for the cells to obtain a final value with a given illumination, and very much longer time—in some cases even days —for this final resistance to rise again to the original when the cell was placed in darkness.

Curves are given which show that the present form will regain its original dark resistance within less than 15 minutes, and it drops from its dark to its light resistance on exposure to light even more rapidly, these times being those required for the cell to make its maximum change in resistance. When the exposures to light and darkness succeed each other rapidly, there is still a change in the cell resistance, this being well shown by rotating before a cell a metal disc with holes in its periphery, a lamp being placed on the opposite side of the disc from the cell. If a battery and a telephone receiver are now put in the cell circuit and the disc revolved at a high rate of speed, a musical note will be heard in the telephone receiver due to the rise and fall of current in the telephone circuit because of the rise and fall of resistance of the selenium.

Mr. Ruhmer's chief object in making his investigations seems to have been the production of apparatus for wireless telephony, using a selenium cell as a receiver of light rays of varying intensity, and supplying some transmitter which would give a beam of light whose intensity would vary with words spoken into it as the strength of the current in an ordinary telephone circuit varies with the words spoken into the transmitter. As the transmitter, Mr. Ruhmer uses in place of the silvered flexible diaphragm employed by Graham Bell and Sumner Taintor, the varying convexity or concavity of which threw varying amounts of light on a selenium receiver, the so-called speaking arc in which there is superimposed on the continuous current through an electric arc the undulatory current from a telephone transmitter circuit, under which conditions the arc acts as a telephone receiver and repeats the sounds spoken into the transmitter. As this action of the arc is due to its varying heat with currents, there is an accompanying light variation, and when this is thrown on the selenium receiver it will cause the resistance of the selenium to vary so that if it is connected in a circuit with an ordinary telephone receiver and battery the telephone receiver will reproduce the sounds.

To prove that the transmission is by light, or, at all events, by actinic rays, Mr. Ruhmer placed a speaking arc before a modified cinematograph and obtained photographic records showing the varying light intensities corresponding to the undulations in the air caused by speed. When these cinematograph films were afterward placed between a selenium cell and a steadily burning arc lamp, the successive variations in the strength of the light that they allowed to pass called forth corresponding changes in the resistance of the selenium cell, and a telephone receiver connected in circuit with the cell reproduced the speech.

It is claimed that this curious and interesting form of phonograph reproduces words with extreme distinctness, the articulation being said to be even superior to that in ordinary telephonic transmission of speech. Using the speaking arc and his sensitive cells, Mr. Ruhmer has telephoned over distances as great as seven kilometers, and the only reason that tests were not made over longer distances was that there was no way in which he could further separate his stations. Curiously enough, the results seem to show that transmission is equally satisfactory, whether made in broad daylight, at night or even during rain and fog. It would seem from this that the ultra-violet rays play an important part.

ARMATURE WINDINGS OF DIRECT-CURRENT DYNAMOS: Extension and Application of a General Winding Rule. By E. Arnold. Translated from the German by Francis B. De Gress. New York: D. Van Nostrand Company. 124 pages, 146 illustrations. Price, $2.00.

This is a highly useful book to anyone whose work involves laying out armature windings, and it is to be regretted that its translation into English was not done years ago. All of the usual and many unusual winding schemes are described, with the aid of diagrams, and the author gives a general formula applying to all possible windings, and the value of the constants in this formula for many particular cases. About the only deficiency in the plan of the book is in the lack of comment upon the relative practical merits and disadvantages of the various windings; the discussion of impractical windings might profitably have been omitted to make room for such advisory comment. With this exception, the most

exacting reader will have hard work to find just cause for criticism. Notwithstanding that eleven years have passed since the original German edition was prepared, the book covers all fundamental windings that are used in present practice.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York.

ENGINE BUILDERS' ASSOCIATION, D. N. McBrier, Erie, Pa., Secretary. Next meeting at Sherry's, New York City, December 1 and 2. 1902.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION, Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, December 9, 10 and 11, 1902.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, Thos. R. Mercein, Milwaukee, Wis.

OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION, Secretary, John Brant, 195 Broadway, New York.

THE ELECTRICAL TRADES SOCIETY (member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Annual Convention of the Electric Storage Battery Company.

The annual convention of the Electric Storage Battery Company was held in Philadelphia on October 13, 14, 15 and 16, the sessions being held at the Colonnade Hotel. On Monday, the 13th, the managers of the sales offices throughout the United States met at the factory, and a tour through the works was made. A luncheon was served at the factory, and then the staff of the Battery Company and the visiting managers of the sales department adjourned to the Colonnade Hotel, and after an address of welcome by the president, Mr. Herbert Lloyd, papers were read by Mr. Charles Blizard, manager of the sales department; Mr. Walter G. Henderson, secretary and treasurer, and Mr. A. B. Stoughton, general counsel of the company. In the evening a reception was held by the president, at his residence, which was attended by the visiting members and officers of the company.

At the Tuesday session, papers were read by engineers of the staff. On Tuesday evening a theatre party was given at the Chestnut Street Theatre. On Wednesday, papers were read by the different members of the staff.

On Wednesday evening a banquet was given at the Germantown Cricket Club, Manhein, Philadelphia.

The banquet hall was almost completely filled by one large oval table, the surface of which was hidden beneath a mass of choicest cut flowers and beds of ferns. Three electric signs, reading, "The E. S. B. Co.," "1888"—"1902," were placed on the walls, and a menu card, having for its cover a small facsimile of the company's price-list, together with an embossed card bearing the Manheim Cricket Club's design and the guest's name were at each plate. Between the various courses, songs were rendered, and marvelous telegraphic despatches from Siam, Afghanistan, Turkey and Sandwich Islands were received on a special wire. Brief addresses by the president, vice-president, secretary and manager of the sales department were made.

Meetings continued on Thursday until noon, when the convention ended. These annual conventions of the staff of the Electric Storage Battery Company are not only most thoroughly enjoyable in bringing together the different sales managers and the corps of engineers stationed throughout the United States, but have been found to be most thoroughly instructive, and it is a feature that is looked forward to annually with growing interest, bringing in touch, as it does, the representatives, and enabling them to discuss the numerous problems which are met with in their work in different localities.

No small measure of the successful growth of the Electric Storage Battery Company can be attributed to the loyalty and earnestness of the staff in their several fields of work and their devotion to the company's interests. A graceful tribute of personal appreciation by his corps was made to Mr. Charles Blizard, manager of the sales department, in the presentation to him of a handsome watch.

New Intercommunicating Telephone.

A new switchless, automatic, intercommunicating telephone, which has now been in use sufficiently long to prove its durability, is being widely introduced by the De Veau Telephone Manufacturing Company, of New York City.

FIG. 1.—SWITCHLESS TELEPHONE—DESK TYPE.

The calling up of the station desired in this system is accomplished by one action, namely, the pressing of the button bearing that designation. This not only rings the bell at the called station, but automatically selects the wire of the individual desired; said connection being private, and remaining set until the receiver is hung up, when the circuits are returned to normal by the releasing of the button.

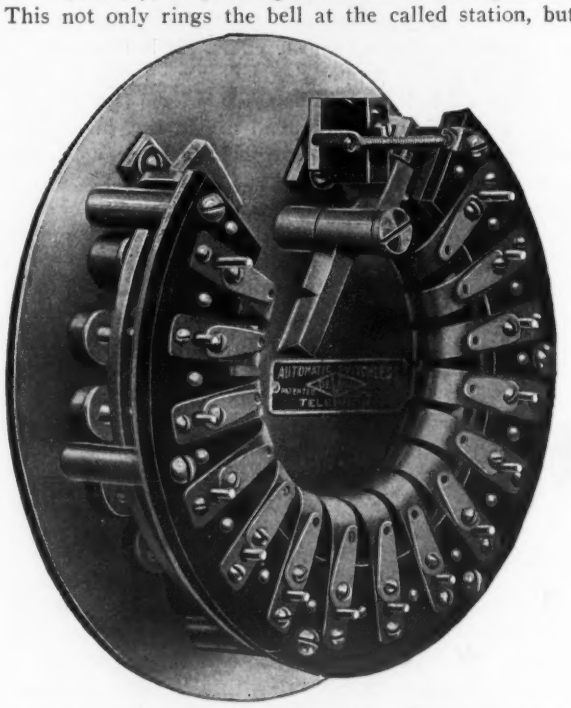


FIG. 2.—DETAILS OF MECHANISM—DESK AND ALL-METAL WALL TYPES.

The release of the button is accomplished by means of a very ingenious apparatus, shown in Fig. 1. In this, the receiver hook engages a release which allows the button, which had hitherto remained depressed, to come back to its normal position. As will readily be seen, this does away with the switch, which had to be returned to zero before the circuits were rendered normal.

All the De Veau telephones are now equipped with the company's new transmitter, which is of the Bell solid-back type. The receivers are of the double-pole solid type, of which the De Veau Company make a specialty. In these receivers the outer shell is cast around the magnets so as to make a solid, permanent adjustment, which construction gives it freedom from all troubles caused by expansion and contraction. The De Veau Telephone Manufacturing Company has also put on the market a very complete line of high-grade switchboard and long-distance apparatus, made up for both magneto and common-battery systems. These combine great simplicity of working parts with a maximum strength of construction, and a very handsome appearance.

FIG. 3.—ALL-METAL SWITCHLESS RESIDENCE TELEPHONE.

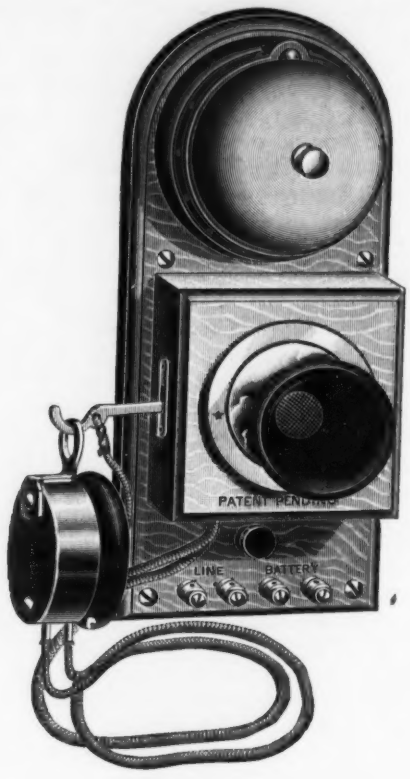
The accompanying illustration shows also the all-metal, flush type of the De Veau automatic, switchless telephone; here the nickel-plated front is flush with the wall so as to be out of the way, and at the same time is attractive in style.

FIG. 4.—AUTOMATIC SWITCHLESS TELEPHONE—WALL TYPE.

Simplified Telephone Apparatus.

An interesting new style of telephone apparatus has been put on the market by the Connecticut Telephone and Electric Company, of Meriden, Conn., employing neither an induction coil nor a permanent magnet in the receiver. This permits the instruments to be produced at a lesser cost.

These instruments are made up in either antique oak or ebony-finished cabinets. The transmitter is heavily nickel-plated, and on the back of the same are mounted the switch hook and all the necessary contacts. The transmitter is of the company's improved long-distance type, thousands of which are in use in exchange work. The receiver is made up of a steel shell, over which is forced a spun brass shell, heavily nickel plated. The magnet is wound with silk insulating wire, and the receiver cord is supplied with an anchor loop, which makes it impossible to run down the batteries, even although the receiver may not be placed on the hook when the parties are through talking. The instrument is also supplied with a high-grade monitor bell. The same grade of workmanship enters into this piece of apparatus as on the company's higher grades of instruments.



TELEPHONE.

This apparatus is designed for use on lines of 1,000 feet or under although it is possible to operate it perfectly on any circuit over which one can ring an ordinary vibrating electric bell, or, in fact, as far as any battery-call telephone. It is also adapted for use in hotel installations, or, in fact, anywhere that a battery-call instrument can be used. It is wired up for use with but two instruments on the same circuit, but may be wired up for any special telephones desired.

Gas Engine Electrical Generating Plants.

The gas engine electrical generating plant is assuming material form in several recent projects for the utilization of gas fuel for power and lighting purposes. A complete equipment of gas generators, gas engines and direct-connected generators is now in process of installation in several important American industrial establishments—namely, the Winchester Repeating Arms Company, New Haven, Conn.; Atlantic Refining Company, Philadelphia, Pa.; Consolidated Industries Company, Batavia, N. Y., and Rockland Electric Company, Hillburn, N. Y. The first of these equipments to be put in operation will be that of the Winchester Repeating Arms Company, at New Haven. The power house has been specially designed for the new gas apparatus, and the entire power for manufacturing and lighting purposes will be furnished from this point. The engines are of Westinghouse make, of the standard vertical, three-cylinder, single-acting type, aggregating 500 hp. They are each direct-connected to 250-volt direct-current generators, and are furnished with gas fuel from Loomis-Pettibone gas generators located in the adjoining producer room. Two additional engines of the vertical type are em-

ployed as auxiliaries. Suitable gas holders are provided for insurance of continuity and uniformity of fuel supply.

The power station of the Atlantic Refining Company will be equipped with a new type of Westinghouse gas engine and one new to American practice—a horizontal, double-crank, double-acting engine. There will be two engines, each of 500 hp, and each engine will be direct-connected to a 350-kw, 25-cycle, three-phase generator, arranged for parallel operation. The engines will be supplied with a rich oil gas of approximately 1,200 B. T. U. per cubic foot.

The equipment of the Consolidated Industries Company is of particular interest, by reason of the arrangements for the most efficient utilization of the fuel supply. The plant will supply three products—metallurgical coke, fuel gas and electricity. A special process will be used, yielding metallurgical coke, and fuel gas as a by-product. The electricity for lighting and power purposes will be generated at a central power station, employing 250-hp gas engines of the new horizontal, double-acting type, direct connected to alternators operating in parallel and supplying current at 1,100 volts to the distributing net-work. A smaller generating unit will also be used for light loads. The installation is an instructive application of processes, having for their object the utilization of waste products.

Another gas power enterprise, and one capable of certain ultimate development, is the Rockland Electric Company, which together with the Ramapo Iron Works and the Ramapo Foundry Company, is comprised in the Snow interests. The installation will consist of an independent gas manufacturing plant, employing the Loomis-Pettibone process, and a power plant containing direct-connected gas engine generator units. The producer plant will supply water gas to the iron plants mentioned, for heating and metallurgical purposes, and electric power to all industrial plants in the vicinity, including the Mahwah branch of the Standard Brake Shoe Company, located about four miles distant from Hillburn. The plant will also supply current for lighting throughout the Ramapo Valley district, of some 14 miles in extent, comprised between the towns of Ridgewood, N. J., on the south and Hillburn, N. Y., on the north. The gas engines installed are also of the new Westinghouse horizontal, double-acting type, of 350 hp, each equipment aggregating 1,200 bhp, or 1,400 bhp maximum. The engines are direct connected to polyphase generators, and constructed to operate in parallel. A 128-hp vertical gas engine unit will also be employed for carrying light loads, and assisting at peak loads. A small amount of direct-current power will be furnished for a short time from one of the main units, which will be temporarily a direct-current unit, but it is the intention to ultimately replace this generator by an alternating-current generator, thus converting the entire plant into a polyphase gas engine central station. All of the machinery for these four installations will be furnished and erected by Westinghouse, Church, Kerr & Company, engineers, New York.

Fuel Feeder and Regulator.

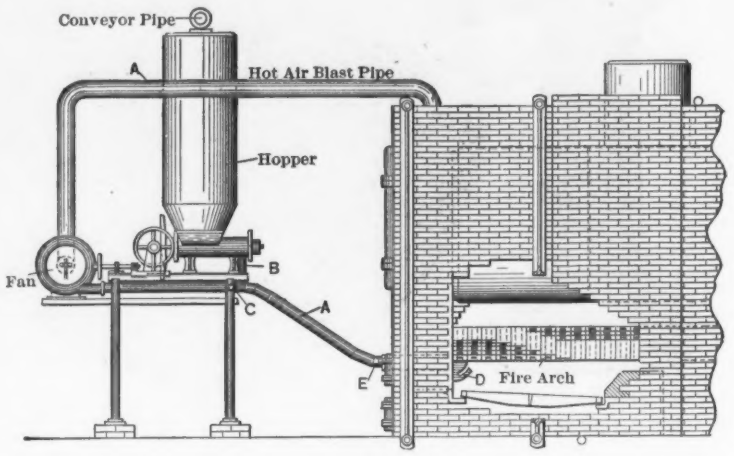
The C. O. Bartlett & Snow Company, Cleveland, Ohio, is introducing a system invented by Messrs Rowe and Bender, for burning soft coal without the production of smoke.

In designing the system, the inventors held that three principles must be considered to secure absolutely perfect combustion. First, the coal must be of uniform size—in other words, it is impossible to secure the same results from burning a lump of coal the size of a man's head and another piece the size of a pea. The coal must be made of even size before perfect combustion can be had. Second, the coal must be of equal moisture, for the same results cannot be obtained from burning coals of different moisture. "Run of mine" coal containing 5 to 6 per cent. moisture will not give the same combustion as slack coal containing 10 to 12 per cent. moisture. Third, the powdered coal must be burned in suspension. If it is swept or pushed into the furnace the heavy particles will fall to the bottom and become a solid clinker, which is objectionable, but by burning in suspension, perfect combustion is obtained.

Under the system perfected by this company, the cheapest kind of slack coal is used. It is first dried down to 2 per cent. moisture, in a dryer designed for the purpose. By a conveyor it is taken to a pulverizer, which grinds it down to 80-mesh fine, making it practically coal dust. It is then conveyed to the feeder outfit, which is the novel feature of the system. The details of construction of this outfit are shown in the accompanying drawing.

The ground coal is stored in an iron storage hopper, or tank, above or near the boiler. An air pipe, *A*, is connected with the feeder spout at the furnace, and above the boiler in the breeching or stack, a blower fan is attached to this pipe, of sufficient size to furnish the necessary air for burning the coal dust. The dust is conveyed by a special worm conveyor from the bottom of the storage bin to a spout, *B*. The speed of this conveyor controls the amount of coal used, and it can be controlled by adjusting a friction disc. From the conveyor the coal is fed direct to the air spout, *A*.

Inside of this spout there is a nozzle which concentrates the air just as it strikes the coal coming down from the conveyor, which gives a thorough mixture of the coal with the air, and at the same time prevents any danger of clogging. The coal is caught by the current of air and blown along the air spout to the furnace spout. Just before



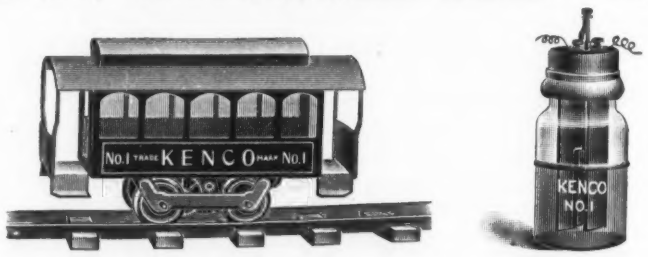
FUEL FEEDER AND REGULATOR.

entering this there is another nozzle having a concave opening or mouth, so that the dust is sprayed upwards against the arch wall where it is at once ignited. This feed spout is bricked in and well protected so that it will not burn out. The blast of air continually passing through this feeder also has a tendency to keep it cool, so there is no danger of burning. At various places in the air pipe there are slides or valves so that the amount of air may be regulated to insure perfect combustion.

Systems of conveyors take care of the coal from the time it is dumped on the overhead coal pile until it is consumed in the furnace, and it is claimed that one laborer can take charge of the entire outfit. It is also claimed that the outfit is no more expensive to install than any ordinary stoker system, and the power required to operate the various parts is a very small item compared with the saving in coal.

Toy Electric Railway.

The coming in of the electrical age has necessarily been accompanied by a demand for electrical toys, and among the most popular of these are electric locomotives and trolley cars. Pretty soon we shall see toy wireless telegraph apparatus. Meantime, the Knapp



TOY TROLLEY CAR AND BATTERY.

Electric and Novelty Company, of West Fifty-first Street, New York, has brought out a new electric railway and battery, appropriately ready for the holiday trade. It is neat and pretty, as will be seen. The car is painted in three colors. The motor is suspended under the car, as in the regular car, and the mechanism is sturdily built.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 5½ per cent. for 60 to 90 days' endorsed bills receivable; 5½ to 6 per cent. for others not so well known. Lenders are firm in their ideas as to rate, yet a considerable business was transacted. In the stock market further liquidation was evident, and the election results had little effect. The pressure, however, relaxed and a covering of shorts ensued, based, to some extent, on a diminished probability of gold exports. The market was irregular and narrow. A generally favorable condition of trade and the maintenance of railroad earnings, with prospects of a further increase as soon as the movement of new corn is well under way, are cited as reasons for the maintenance of, if not the improvement in, the values of railroad securities. Manhattan was one of the features, and sharply advanced from 135⅝ to 137½, it being claimed that a very considerable increase was taking place in the earnings of the company, owing to the practical completion of the electric power equipment on all of the lines of the system. United States Steel stocks sold off rather sharply for a time, it being claimed that concessions as to prices and increasing competition in the trade were bringing out long holdings. Comparatively little attention was paid to other industrials, and no features of interest were noted. Tractions were weak and drooping. Brooklyn Rapid Transit closed at the lowest quotation—60—being a net loss of 2⅞ points. This stock reached 63⅞ at one time during the week. Metropolitan Street Railway also closed at the lowest figure, namely, 138½, being a net loss of 2¼ points. All of the electrics showed decreases; General Electric closed at 180, after reaching 187, being a net loss of 6 points, the closing quotation being also the lowest. Westinghouse closed at 212, thereby losing 1¼ points; Western Union 90¼, a loss of ¾ of a point. Commercial Cable closed at 175, a net loss of 2 points. Following are the closing quotations of November 11:

NEW YORK.

	Nov. 3.	Nov. 11.		Nov. 3.	Nov. 11.
American Tel. & Cable..	90	90	General Electric	185¼	177
American Tel. & Tel...	163	—	Hudson River Tel.....	—	—
American Dist. Tel.....	38	36	Metropolitan St. Ry....	140	136⅝
Brooklyn Rapid Transit.	62¾	59⅛	N. E. Elec. Veh. Trns..	—	—
Commercial Cable	—	—	N. Y. & N. J. Tel....	—	163
Electric Boat	19	20	N. Y. E. V. T. Co....	12	10½
Electric Boat pfd.....	35	35	Tel. & Tel. Co. Am....	—	—
Electric Lead Reduc'n..	3⅝	—	Western Union Tel.....	91¼	89
Electric Vehicle	4½	4	Westinghouse Com.....	212	199
Electric Vehicle pfd.....	9	10	Westinghouse pfd.....	211	201

BOSTON.

	Nov. 3.	Nov. 11.		Nov. 3.	Nov. 11.
American Tel. & Tel..	164½	161	Western Tel. & Tel. pfd	—	99
Cumberland Telephone..	—	125	Mexican Telephone	2⅛	2⅛
Edison Elec. Illum.....	—	265½	New Eng. Telephone....	137½	137
General Electric	—	178	Westinghouse	—	95
Western Tel. & Tel....	—	27	Westinghouse pfd	—	95

PHILADELPHIA.

	Nov. 3.	Nov. 11.		Nov. 3.	Nov. 11.
American Railways.....	—	54½	Phila. Traction	98	98
Elec. Storage Battery...	84	81*	Phila. Electric	9	8½
Elec. Storage Bat'y prd.	—	—	Pa. Elec. Vehicle	—	—
Elec. Co. of America...	9⅝	9¼	Pa. Elec Vehicle pfd..	—	—

CHICAGO.

	Nov. 3.	Nov. 11.		Nov. 3.	Nov. 11.
Central Union Tel.....	—	—	National Carbon pfd....	—	100
Chicago Edison.....	—	174	Northwest Elev. Com..	—	—
Chicago City Ry.....212		210	Union Traction	17¼*	15
Chicago Tel. Co.....	—	—	Union Traction pfd....	47	45
National Carbon	—	—			

* Asked.

DIVIDENDS.—The directors of Niles-Bemont-Pond have declared the regular quarterly dividend of 1½ per cent. on the preferred payable November 15. The directors of Pratt & Whitney have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable November 15. American Railways directors have declared a quarterly dividend of 1½ per cent. This increases the dividend basis from 5 to 6 per cent. The American Railways Company's surplus now amounts approximately to $380,000, or about 10 per cent. of the capital, without allowing for quarterly dividend of 1½ per cent. just declared. The gross earnings for the three months ending September 30 were $353,193, an increase over the same quarter of the preceding year of $90,251. The directors of Brooklyn Union Elevated have declared a regular dividend of 1½ per cent. and ½ per cent. extra on preferred stock, payable December 31, to stockholders of record December 23. The last regular dividend declared on the preferred stock was 1 per cent. Hereafter the dividend will be declared semi-annually. At the meeting of the United States and Hayti Cable Company, an annual dividend of 5¼ per cent. was voted on the preferred stock.

TELEPHONE GROWTH.—October was the best month Chicago Bell Telephone ever had. The net gain was 2,940 telephones, making the total in the city about 58,000, or a gain of 29,000 since President Sabin commenced his aggressive campaign. The Western Telephone Company is planning to spend $1,000,000 during the coming year on its southwestern property, mostly for new extensions, and it will make proportionately large expenditures on its other properties. The earnings of the company are making steady and satisfactory gains, and the outlook for the coming year is that a record-breaking revenue will be secured.

MINORITY STOCKHOLDERS OF MICHIGAN TELEPHONE.—Minority stockholders of the Michigan Telephone Company, representing about $200,000 of stock, have formed a protective committee, consisting of Charles F. Hammond, of Detroit; Samuel T. Douglas, of Detroit, and George W. Patterson, of Ann Arbor, to take such protective action as shall be considered advisable in behalf of stockholders. Depositors under this plan are assessed 25 cents per share for expenses.

ST. JOSEPH (MO.) DEAL.—E. W. Clark & Co., of Philadelphia, have bought up and consolidated the street railways and gas and electric companies of St. Joseph, Mo. They propose to spend $400,000 in improvements and extensions, and propose to sell the preferred stock, paying 5 per cent. dividends, with a handsome bonus of common stock. St. Joseph is the third city of Missouri.

GENERAL ELECTRIC ORDERS.—According to the *Wall Street Journal*, General Electric people state that there is no let-up in the contracts for new business. The company is now taking orders at the rate of between $800,000 and $900,000 per week, and are sold far ahead into 1903.

Commercial Intelligence.

THE WEEK IN TRADE.—Satisfactory trade reports continue to be received by the mercantile agencies. Jobbing trade was active, at most markets exceeding last year's. Spring sales, says *Bradstreet's*, are of good volume, indicating confidence, and enormous shipments of all classes of merchandise have congested the railroads, already fully occupied in trying to move supplies of fuel to consumers and crops to the market. Good collections are the rule, few exceptions to this being noted, and those only where rapid marketing of grain has been interfered with, or retail demand for heavy goods has been held in abeyance. The railway earnings for October were 4.8 per cent. larger than last year, and 14.2 per cent. above 1900. Iron and steel show little change. Steel rail makers are still busy, and an immense tonnage will have to be carried over into next year. Car builders are purchasing large quantities of plates for next year. Many furnaces have been compelled to bank because of the poor receipts of coke. and there is little evidence of improvement in the railway situation, motive power being utterly inadequate. The copper market was very dull, and prices continued downward. Business was light, both for home consumption and export. The following are the ruling quotations: 11.62½c. to 11.87½c. for Lake; 11.60c. to 11.70c. for electrolytic and casting stock, and 11c. for standard. The number of business failures during the week ending November 6, as reported by *Bradstreet's*, number 148, as against 194 of the previous week, and 191 the corresponding week last year.

THE SHERWIN-WILLIAMS PAINT COMPANY, of Cleveland, Ohio, is equipping all its works for electric power distribution. It recently purchased for its Cleveland works three alternating-current generators of 150-kw, 120-kw and 75-kw capacity, respectively, and about 500 horse-power in induction motors, which will be used to drive all its paint and varnish making machinery. It has also equipped its Newark, N. J., works with one 75-kw alternating-current, engine-type generator, and a number of motors, and is about to install a duplicate plant at the same works. At Pullman, Ill., it is putting in a 120-kw alternating-current generator and one of 100-kw, and about 200 hp in induction motors. The electrical apparatus for the several plants is being furnished by the Westinghouse Electric and Manufacturing Company.

THE UNITED STATES COAL COMPANY is about to equip its soft coal mines, at Dillonvale, Jefferson County, Ohio, with electrical machinery, and for that purpose has recently purchased from the Westinghouse Electric and Manufacturing Company two 150-kw, 550-volt, direct-current generators and two 10-ton mining locomotives. Electric power will be used for the operation of the locomotives and other mining machinery.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended November 1: Argentine Republic—36 pkgs. material, $1,316; 2 pkgs. machinery, $151. Antwerp—6 pkgs. machinery, $425; 38 pkgs. material, $1,800. British Possessions in Africa—87 pkgs. material, $1,274. Boulogne—8 pkgs. material, $100. Barcelona—1 pkg. material, $39. British East Indies—3 pkgs. machinery, $237; 8 pkgs. material, $270. Brazil—51 pkgs. material, $2,265; 233 pkgs. machinery, $6,966. British West Indies—1 pkg. machinery, $150; 16 pkgs. material, $254. Bremen—2 pkgs. machinery, $175. Central America—51 pkgs. material, $132. Cuba—25 pkgs. material, $790. China—12 pkgs. material, $470. Copenhagen—1 pkg. machinery, $20. Dresden—2 pkgs. material, $141. Glasgow—1 pkg. machinery, $50. Havre—44 pkgs. machinery, $775; 43 pkgs. material, $758. Hamburg—27 pkgs. material, $2,373. Japan—75 pkgs. machinery, $8,779; 43 pkgs. material, $1,381. Konigsburg—3 pkgs. material, $263. Liverpool—182 pkgs. machinery, $11,378. London—131 pkgs. machinery, $2,358; 4 pkgs. material, $265. Manchester—120 pkgs. machinery, $22,892; 21 pkgs. material, $2,332. Mexico—2 pkgs. machinery, $300; 12 pkgs. material, $467. Malta—12 pkgs. material, $125. Marseilles—25 pkgs. machinery, $175. Newcastle—1 pkg. machinery, $300. Preston—1 pkg. material, $48. Peru—2 pkgs. material, $57. Philippine Islands—34 pkgs. material, $1,689. Rotterdam—5 pkgs. material, $200. Southampton—36 pkgs. material, $3,359; 7 pkgs. machinery, $560. Stockholm—1 pkg. machinery, $700. Trieste—13 pkgs. machinery, $5,793. Uruguay—3 pkgs. machinery, $61. U. S. Colombia—11 pkgs. material, $158. Venezuela—42 pkgs. material, $297.

ORDERS FOR SUBWAY CARS.—Mr. E. P. Bryan, the general manager of the Interborough Construction Company, which has the building and operating of the Manhattan tunnel, has given the first order to a St. Louis firm for the cars that are to be used in the subway in Manhattan. Owing to the lack of time in which the fireproofed wood could be furnished, these cars are to be made fireproof by the use of asbestos. The general plan in this respect is that all electrical wires and other parts from which danger of fire might arise are to be either encased or covered within grooves of asbestos. Mr. Bryan was informed that Charles T. Yerkes had cabled to the United States from London that he had given his first order for the cars in the London subway, and there will be a good-natured rivalry between the two companies as to the excellence of the cars and the quickness with which they can be made. Mr. Yerkes stated in his cablegram that he had decided to use fire-proofed woods, treated by an electrical process. Mr. Bryan, in speaking of the cars, said: "We had intended using fire-proofed woods, as Mr. Yerkes has decided to do, but found eventually that it would be impossible. We had tests made of all sorts and conditions of woods, and practically decided to use the electric fire-proofed woods which stood the best tests of all, but then came a stumbling block in the shape of the fact that in all probability the woods could not be treated and ready for use in time for us to use them on the cars which will be needed by next October. So those the first order provides for will contain only metal covered woods and asbestos. In all probability when our second order is given we will follow Mr. Yerkes's example and have the electrically treated wood."

ORDERS FOR CRANES AND HOISTS.—The crane and hoist demand is in excellent condtion, as reported by Pawling & Harnischfeger, Milwaukee, Wis. They advise of their recent booking of such orders, as follows: Baldwin Locomotive Works, Philadelphia, two 10-ton cranes; Manitowoc Steam Boiler Works, Manitowoc, Wis., one 35-ton crane; Consolidated Railways, Light and Power Company, Wilmington, N. C., one 10-ton crane; Pennsylvania Lines West of Pittsburg, Ft. Wayne, Ind., one 1½-ton hoist; The Lorain Steel Company, Johnstown, Pa., one 7-ton crane; American Sheet Steel Company, Cambridge, Ohio, one 5-ton crane; Berlin Machine Works, Beloit, Wis., one 1½-ton hoist; The Lorain Foundry Company, Lorain, Ohio, one 5-ton crane; Allis-Chalmers Company, Chicago (for export), one 30-ton crane with 4-ton auxiliary hoist; Colean Implement Company, Peoria, Ill., one 10-ton crane; Allis-Chalmers Company, Fraser & Chalmers' Works, Chicago, one 30-ton crane, with 8-ton auxiliary hoist; Gruson Iron Works, Eddystone, Pa., one 20-ton crane; Isaac G. Johnson & Co., Spuyten Duyvil, N. Y., one 3-ton hoist; Allis-Chalmers Company, Chicago, one 5-ton crane; Chicago, Milwaukee and St. Paul Railway, West Milwuakee shops, one 25-ton crane.

ST. LOUIS MUNICIPAL PLANT.—The city of St. Louis will shortly try an experiment in public ownership. Two electric lighting plants, owned and operated by the city, will be running. President Phillips, of the Board of Public Improvements, has prepared plans, to be approved by the board, for the plants. Bids will be let at once. One plant is to be operated at the City Hall, lighting that building, the old City Hall, the four courts, the Court House and Engine Company No. 6. The other plant, located at the insane asylum, will furnish light for that institution, the poorhouse, the female hospital and Engine Company No. 35. The construction of the two plants will cost $45,000. Heretofore the city has paid $35,000 a year for lighting the public institutions named. The usual flimsy calculations are put forward to show the saving that will be made.

AFTER AUSTRALIAN TRACTION CONTRACTS.—The electrical engineering and contracting firm of Noyes Brothers, Melbourne and Sydney, Australia, which represents the Westinghouse interests in the Antipodes, and O. Hoes, Australasian representative of the British Brush Electric Engineering Company, Limited, controlled by the British Electric Traction Company, Limited, are reported to be negotiating for the important contract for the construction of some 50 miles of electric lines in the suburbs of Melbourne. It is proposed to build a road, to be operated between Brighton and St. Kilda, and another from Newmarket to Essenden. A conference of municipalities south of the Yarra is also to be convened, for the purpose of considering a scheme of electric tramways to be carried out as municipal undertakings.

RECENT BALL ENGINE ORDERS.—A direct-connected exciter unit has been installed by the Cedar Rapids Electric Light and Power Company, Cedar Rapids, Iowa. The Ball Engine Company, Erie, Pa., furnished the engine. The Miehl Printing Press Manufacturing Company, Chicago, Ill., has recently placed in operation a 300-hp engine, built by the Ball Engine Company. The Stromberg Electric Light, Heat and Power Company, Stromberg, Neb., recently put in operation a Ball engine. The Williams Coal Company, McHenry, Ky., has recently started an electrical unit of 200 hp. The engine was furnished by the Ball Engine Company, and the generator by the General Electric Company.

HALL SIGNAL PLANT.—The Hall Signal Company will enlarge its plant, located at Garwood, N. J., in the near future. When the extension is completed the capacity for manufacturing railroad signals will be nearly doubled. The cost of the improvements contemplated will amount to at least $50,000, which sum when paid will be appropriated out of current earnings. It is officially stated that business has expanded so rapidly that the company's facilities for manufacturing have become inadequate. Deliveries have been delayed in some cases for months. It is expected that with the increased facilities less trouble will be had in making deliveries according to contract.

EXPORTS OF MANUFACTURES.—The exports of manufactures from the United States in the nine months ending with September, 1902, are larger than those in the corresponding period of any other year in the history of the country, with the single exception of 1900. The total for the nine months is $311,302,441, against $298,660,-551 in the corresponding months of last year, and $338,678,243 in the corresponding months of 1900. Comparing 1902 with 1892, the increase is nearly 200 per cent., the figures of 1892 being $111,290,024; while comparing 1902 with 1888, the growth in nine months' exportations of manufactures is from $99,840,074 to $311,302, 441.

GERMANS GET VALPARAISO TRACTION CONTRACT.—The contract for the construction and operation of the Valparaiso, Chili, electric traction system has been awarded jointly to the Allegemeine Electritaats Gesellschaft and Schuckert & Company, both of Berlin, Germany. The existing horse-car line—the Ferro Carril Urbano—is to be converted. Its length is about eight miles. A new road, about 10 miles in length, is to be constructed from the City of Valparaiso and its principal suburb, Vina del Mar.

ANOTHER LIGHT AND POWER PLANT FOR MEXICO.—Senor Vicente Viegra, an extensive land owner in the State of Jalisco, Mexico, is about to let contracts for the equipment of an electric plant which is to be constructed in the town of Tamazula de Gordiano. The plant will be used for both light and general power purposes.

MEXICAN HYDRAULIC PLANT.—Senor Felipe Rocha, of the City of Mexico, proposes to construct an hydraulic plant on the River Tepic, at a point called El Salto, about two miles from the City of Tepic, Mexico, to furnish power for lighting, and to supply current for operating various manufacturing plants in the immediate vicinity.

EQUIPMENT PENDING FOR MEXICAN TRAMWAYS.—The Mexico Electric Tramways, Limited, of the City of Mexico, of which A. E. Worswick is the chief engineer, is about to make purchases of further equipment in the United States. A portion of the road is to be laid in double track.

NEW YORK TELEPHONE COMPANY added over 5,000 new subscribers in October, making a total of over 100,000 Bell subscribers in its territory; and it also opened a commodious new exchange, "Morningside," for the benefit of its upper West Side patrons.

ST. PAUL TROLLEY SHOPS.—St. Paul dispatches states that the Twin City Rapid Transit Company has acquired title to a tract of land in that city, on which the company proposes to erect shops that will add greatly to its facilities for building and repairing cars.

General News.

THE TELEPHONE.

LITTLE ROCK, ARK.—It is announced that the Southwestern Telegraph and Telephone Company proposes to build a telephone line from Memphis, Tenn., to Jonesboro and other points.

LOS ANGELES, CALIF.—Bids will be received by the Board of Supervisors in Los Angeles, Calif., for telephone franchises in Covina, Rowland, Glendora and Lardsburg up to 2 P. M., Nov. 24. C. W. Bell is the County Clerk.

SAN FRANCISCO, CALIF.—The Commercial Pacific Cable Company has completed its 6-mile underground conduit from the ocean beach at San Francisco to the Postal Telegraph Company's main office on Market Street, whence the cable will be operated. The land wire will be at once drawn in to the conduit, which consists of a three-inch wrought iron pipe buried about two feet. The cable ship is expected during the present month and if the weather conditions are favorable for laying the cable, commercial business should be carried on before Christmas.

DENVER, COLO.—Promoters of the new telephone company will ask for a franchise in this place. H. H. Hake, of this city, is interested.

WASHINGTON, GA.—The Wilkes Telephone and Electric Company, of Washington, Ga., has just completed long distance lines to a number of nearby towns. The Southern Bell has also completed a line to this city, connecting with its long distance service.

LEWISTON, IDAHO.—The Nezperce Co-operative Telephone Company has completed its line from Mohler to Culdesac, connecting with the Lewiston line direct.

GREER, IDAHO.—The Greer-Pierce City Telephone Company has completed the construction of the line to Pierce and the line is now giving excellent service. Mr. Dulmage, the proprietor, is now extending the line from Greer to Orofino. At Orofino the line will connect with the Inland Telephone Company. The Greer-Pierce Company will soon commence construction work on four miles of line from Greer to connect with the Ramey line which taps the entire reservation.

LEROY, ILL.—The Leroy Telephone exchange and toll lines have been sold to T. L. Parks.

LOVINGTON, ILL.—The Argenta Telephone Co., has been purchased by L. Gerber, P. E. Gerber and S. O. Hilbrant.

PEARL CITY, ILL.—The Pearl City Independent Telephone Company, capital $15,000, has been incorporated.

WARSAW, ILL.—A franchise has been granted to M. T. Chenoweth on behalf of the Farmers' Telephone Company, to construct a telephone line in this place.

SPICELAND, IND.—Griffin & Ratliff will extend their telephone lines to connect Painters, Wiggs and other towns.

INDIANAPOLIS, IND.—The Home Telephone Company, of West College Corners, has been incorporated. The capital stock is $4,000. The directors are Charles Stout, J. C. Barkney and W. H. Hawley.

GAS CITY, IND.—The Home Telephone Company, of Gas City and Jonesboro, have filed articles of incorporation with the Secretary of State. The capital stock is $50,000, but this will be subsequently increased. The directors are E. H. Neal, Fred Schroeder, C. H. Holson, W. G. Woodard and K. V. Haymaker.

SHENANDOAH, IA.—The Independent Mutual Telephone Company is building a telephone line here.

BANCROFT, IA.—The Kossuth Telephone Company has purchased the Algona exchange and will connect it with the rural lines being built in the county.

ATCHISON, KAN.—A new independent telephone exchange has been incorporated at this place.

LOUISVILLE, KY.—The Marshall County Telephone Company, capital $5,000, has been organized.

NEW ORLEANS, LA.—The strike of the linemen of the Cumberland Telephone Company which has been in progress for the past three months has been settled through the efforts of Railroad Commissioner Sims. It is stated that the men accepted the company's terms.

ROCKLAND, ME.—A franchise has been granted the Knox Telephone Company to construct a telephone system here.

AUGUSTA, ME.—The Crosby Telephone Company, of Augusta, has been incorporated with a capital of $10,000. Byron Boyd is president and M. W. Crosby, treasurer.

CARLETON, MICH.—At the annual meeting of the People's Telephone Company these officers were elected: Joseph Waltz, president; F. L. Edwards, secretary and treasurer; directors: Joseph Waltz, Earl Gildsmith, Wayne; Jesse Butler, Willow; T. J. A. Milliken, New Boston, and F. L. Edwards, Carleton. The company will make some improvements.

MISSOULA, MONT.—The Rocky Mountain Bell Telephone Company has let a contract for 1,000 poles to be used in the reconstruction of the long distance line between this city, Butte and Helena. It will string two new wires, one direct to Butte and one to Helena.

YORK, NEB.—E. W. Barnes, of the American Telephone Company, is endeavoring to secure a franchise to put in an independent exchange in York.

FREMONT, NEB.—The directors of the Fremont Telephone Company will issue an additional $10,000 worth of stock to build forty miles of rural lines into Saunders County.

RENO, NEV.—Sixty new telephones have been placed in use in Reno in the past three weeks and the local exchange now numbers more instruments than the rest of the State combined.

BINGHAMTON, N. Y.—New York State Telephone is now in possession of the Binghamton Telephone Company through transfer of the stock of the latter.

CHARLOTTE, N. C.—The Southern Bell Telephone Company has ordered the necessary material for placing its wires underground.

NORWALK, OHIO.—The Local Telephone Company, of Norwalk, has increased its capital from $250,000 to $400,000.

PARKMAN, OHIO.—The Parkman Telephone Company has been incorporated with a capital of $996, by H. H. Jones, W. C. Pay, A. C. Wiggant, C. M. Bundy and Frank Owen.

AKRON, OHIO.—The Akron People's Telephone Company has paid its second quarterly dividend of one per cent. At present the company is earning 7 per cent. on its capital stock, although it has been in operation only about two years. The gross earnings for September were $6,413; operating expenses, $3,320; interest on bonds, $1,390; net for stock, $1,793.

TOLEDO, OHIO.—The plant of the Toledo Home Telephone Company was formally turned over by the Central Construction Company on November 3. At the meeting of stockholders on that day a plan was formulated for pooling the stock to prevent it from falling into the hands of a rival company. It is claimed that new contracts are coming in at the rate of 12 to 15 per day and at present the list is about 5,500.

WEST ALEXANDER, PA.—The Farmers' and Merchants' Telephone Company is being organized here.

BLOOMSBURG, PA.—The United Telephone & Telegraph Company is extending its line from Bloomsburg to Briarcreek.

CHESTERFIELD C. H., S. C.—The Chesterfield Telephone has secured subscriptions to stock, and a number of subscribers for a proposed telephone system in Cheraw, S. C. The South Carolina Long Distance Telephone Company is at present in Cheraw.

LETCHER, S. D.—The Letcher Telephone Company, capital $10,000, has been incorporated by Wm. D. Ryan, Edw. Welch and Edw. Menaugh.

WAVERLY, VA.—The Waverly Telephone Company, one of the largest rural telephone companies in the State; is rapidly extending its lines to the various centers of population in the county.

FREDERICKSBURG, VA.—A telephone system is being built between this place, Rappahannock and Tappahannock.

BRISTOL, WIS.—The Bristol Telephone Company, capital stock $4,000, has been incorporated by F. E. Stevens, J. A. Rowbottom and C. L. Marsh.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—The Alabama Steel and Wire Company has purchased a large tract of land at Gadsden; the Gadsden & Attalla Electric Railway and the Gadsden Ice Factory. Nearly $5,000,000 will be expended in Gadsden.

SAN FRANCISCO, CALIF.—The Pyramid Power Company has been incorporated in San Francisco by Attorney Frank P. Deering, G. M. Sutherland, W. R. Rhoades, Allen I. Kittle and L. A. Gibbons.

SAN FRANCISCO, CALIF.—The sale of the franchise applied for by the San Francisco Electric Protective Company has been advertised by the San Francisco supervisors. An underground conduit system covering a large part of the city will carry the company's wires and the latest type of burglar alarm apparatus will be installed.

SAN FRANCISCO, CALIF.—The Sierra Electric Power & Water Company, C. H. Carter, president, will construct an electric power plant and a canal. The proposed ditch will begin at Little Sugar Pine Creek and continue to a point above Grizzly Ditch near Buchanan Crossing where the power plant will be located. The ditch will be extended to Carters, Tuolumne County, where a reservoir will be constructed.

STIRLING, COLO.—A franchise has been granted to O. P. Sells, of Pueblo, Colo., for an electric lighting plant. This franchise was given after an investigation by the town into the matter of a municipal plant. Preliminary work is now being done, and building operations will begin in thirty days.

SOUTH NORWALK, CONN.—The city has voted to appropriate $15,000 to enlarge the municipal electric lighting plant and $5,000 to equip the system with meters. The plant yielded a profit of $5,550 in 1902.

MONTPELIER, IDAHO.—An electric light proposition is absorbing the interest of citizens of this place and a home company has been formed, the stock having been all taken up. Orders for lighting are already being solicited throughout the city.

BUTLER, IND.—The Butler Arc Light Company, of Butler, Ind., has been incorporated. Capital stock, $25,000. The incorporators are Frank E. Good, Henry Grube and W. M. Barden, all of Butler.

LAURENCEBURG, KY.—A proposition to issue $20,000 water and electric light bonds will be submitted to a vote.

NEW ORLEANS, LA.—The Southern Pacific Railroad Company is supporting a $250,000 project to convert a county in Texas into a thriving center by the use of electricity to operate a 10,000-acre rice plantation in Harris County. Fuel oil will be used in the central power plant. The electric power will be used for operating rice mills, lighting the homes of the farmers, supplying heat and operating a network of trolley lines.

BANGOR, ME.—Joseph P. Bass, of Bangor, who a year ago purchased all the stock and bonds of the Oldtown Electric Light Company and the Oldtown Gaslight Company, has sold those properties to the Public Works Company, of Bangor.

WOODRUFF, S. C.—It is reported that an electric power plant will be built at Van Patton shoals, which has been bought by A. B. Groce, of Greess, S. C. An electric railway may also be built.

HIGH POINT, N. C.—The High Point, Greensboro and Winston-Salem Electric Company is preparing for business and has deposited a sum of money with the town of High Point to perpetuate and guarantee its charter.

CONCORD, N. C.—The Concord Electric Light Company has secured an extension of franchise and the owners of the property, Burton & Scott, will at once put in a new plant to cost $75,000, furnishing at least 30 arc and 100 incandescent lights.

SALISBURY, N. C.—The Salisbury Light and Power Company has been organized with a minimum capital of $50,000. J. S. Henderson, T. H. Vanderford and others are interested. J. S. McCubbins is treasurer. Work will begin on an electric railway at an early date. It is proposed to build a line four miles long to the Yadkin river next summer.

PHILADELPHIA, PA.—The ordinance giving to the Philadelphia Electric Company the right to occupy all the streets of Philadelphia is now before the Electrical Committee of the City Council. The object of the bill is to enable the company to secure directly from the council franchises which heretofore have been obtained only through subsidiary companies. The Philadelphia Electric Company was organized under a New Jersey charter, but recently has taken out a Pennsylvania charter and now desires legislation in its own name.

SPARTANBURG, S. C.—Geo. E. Ladshaw will develop a large power plant on Colorado River in Texas for a syndicate of Austin, Tex., capitalists. The power will be used in a cotton mill.

CHATTANOOGA, TENN.—Bids have been opened for lighting the city. If the price is not materially reduced the city council, it is said, may build a municipal plant.

AUSTIN, TEX.—Hon. J. W. Maxwell, of Austin, acting as the representative of Eastern capitalists, is preparing a proposition which he will submit to the city council of Austin for rebuilding the dam across the Colorado River at that place and utilize the water power thus derived for generating electric energy for private enterprises. This dam was destroyed by a flood in the Colorado river more than three years ago.

AUSTIN, TEX.—Steps have been taken looking to the purchase by the State of Texas of the old water works, electric light and power plant now owned by the city of Austin. The city has no use for the plant since it has a new and up-to-date plant situated some distance from the old plant. The latter was operated for many years by a private company and was only recently acquired by the city, the object of the latter being to do away with the opposition business of the acquired plant. If the State is successful in purchasing the plant it will be used to supply the several state eleemosynary institutions and capitol at Austin with water, light and power.

SPRINGVILLE, UTAH.—At a mass meeting held here recently it was unanimously voted to grant a franchise to Provo, Utah, capitalists to establish an electric street car line through Springville City.

LYNCHBURG, VA.—The Lynchburg Traction and Light Company has awarded a contract to the General Electric Company for complete electric equipment for the plant which the Lynchburg company proposes to establish at Reussens, on James River. The amount involved is $60,000. The company has purchased the dam and seventy acres of ground at Reussens and proposes to erect there at once a power house by which it will convert the water power of the James into electric current for the operation of plants at Reussens and in Lynchburg.

GUADALAJARA, MEX.—A merger of the holdings and interests of the Guadalajara Tramvias Company, Ltd., and the Electric Light Company, Ltd., both of the city of Guadalajara, has been effected and is to be ratified at a meeting of the stockholders of the former company to be held at Guadalajara.

CITY OF MEXICO, MEX.—German Roth and associates, all prominent mining men of Temascaltepec, Mexico, have just been granted a concession by the Mexican government to construct and install the hydraulic works necessary to utilize 2000 litres of water per second from the Rio Verde River, for power to be used in that town or to be transformed into electric energy for transmission to any points that the concessionaries may desire.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light and Power Company will spend $2,000,000 in betterments.

OPELIKA, ALA.—An electric railway line for passenger and freight purposes will be constructed from Opelika to Auburn, a distance of about 7½ miles.

SAN FRANCISCO, CALIF.—United States District Judge Welburn has decided the famous freight-franchise case of the Pacific Electric Railway Company vs. the City of Los Angeles, in favor of the city. Judge Welburn decides that the railway company is not entitled to the franchise. It is likely that the case will be appealed.

HARTFORD, CONN.—The Connecticut Railway & Lighting Company has secured rights of way for the proposed trolley line from Waterbury over Southington Mountain to Milldale. The proposed line will put Waterbury in direct trolley connection with New Haven, Hartford and Meriden.

ROME, GA.—It has been decided to extend the local trolley line to Lindale at a cost of $50,000

EVANSVILLE, IND.—The Evansville Suburban & Newburg Electric Railway Company proposes to build an extension to Rockport, a distance of 23 miles.

VINCENNES, IND.—The Southern Indiana Traction Company has been granted a fifty-year franchise to operate cars in Vincennes. The company will build an interurban line between Jasper and this city.

FT. WAYNE, IND.—The Ft. Wayne, Buffton & Richmond Traction Company has been incorporated. The capital stock is $50,000. The incorporators are Edward Manier, of Versailles, Ohio, Frank X. Schaffer, of Dayton, Ohio, Chas. Dust and Wm. F. Dinnen, of Ft. Wayne.

WARSAW, IND.—The Warsaw & Winona Electric Railway Company has been incorporated. The line has been built and is ready to be put in operation between Warsaw and Winona Assembly grounds at Winona Lake. The capital stock is $50,000. J. E. Byers, of Rochester, is president of the company; A. N. Duke, of Peru, and W. N. Smythe, of New York, are vice-presidents; S. C. Dickey, of Indianapolis, secretary.

NIAGARA FALLS, N. Y.—The Niagara Traction Automobile Company, of Niagara Falls, has been incorporated with a capital of $25,000. Directors: W. R. Campbell and F. A. Dudley, Niagara Falls; F. A. Babcock, Buffalo.

SYRACUSE, N. Y.—Capitalists identified with the Syracuse, Lakeside and Baldwinsville Railroad have purchased the Fulton Street Railway and will extend it and the Lakeside to form a trolley line between Syracuse and Oswego.

NEW YORK, N. Y.—Preparations are being made by the Long Island Railroad Company to introduce electricity on the Rockaway branch. It is the intention to widen the trestle across Jamaica Bay, and the entire Rockaway branch will be operated by electricity.

NEW YORK, N. Y.—The Manhattan Railway Company is now operating electric trains between the Battery and 155th Street, Harlem. Fifteen electric trains are now in service, but the number will be constantly increased and the number of steam locomotives correspondingly reduced.

SYRACUSE, N. Y.—The Rapid Transit Railway Company will extend its road from Liverpool to Oswego. The extension from Syracuse to Liverpool has recently been made. The total cost of the road will be $80,000. It is also probable that the Rapid Transit Company will extend south to Tully.

GLENS FALLS, N. Y.—The strike of the motormen and other employees of the Hudson Valley Railway has, after a duration of nine weeks, been settled by a compromise. The company has made concessions in the matter of advancing wages, and the employees will withdraw from the Troy Union and form one of their own. The strike has, it is said, cost the company about $200,000 in extra expenses and loss of business, and the employees over $20,000 in loss of wages. The expenses for the militia cost over $400,000 and the loss of trade in general was very large.

EAST LIVERPOOL, OHIO.—The East Liverpool & Rock Springs Railway Company has made application for a franchise to enable it to extend its line from Chester to Congo.

MEDINA, OHIO.—The village council has granted a franchise to the Cleveland & Southern Railway Company enabling it to complete its line through town and build to Wooster.

COLUMBUS, OHIO.—The Central Market Street Railway Company has placed a contract with the Electric Storage Battery Company for a storage battery outfit to consist of 290 cells.

COLUMBUS, OHIO.—A syndicate headed by Senator Foraker has taken up the financing of the Urbana, Mechanicsburg & Columbus Railway, at the head of which is Gen. Axline, of Columbus.

SANDUSKY, OHIO.—The Lake Erie, Bowling Green & Napoleon Railway, whose line from Bowling Green to Pemberville is nearly completed, is planning to extend the road to Lakeside and Marblehead next spring.

CINCINNATI, OHIO.—The Falk Company, of Milwaukee, is arranging with W. C. Compton, promoter of the Cincinnati, Milford & Goshen Traction Company for the construction of the road. It is estimated it will cost $1,000,000.

TOLEDO, OHIO.—The freight business of the Toledo interurban lines has increased so rapidly of late that it has been decided to double the facilities of the present freight station by the erection of a duplicate of the present building.

CINCINNATI, OHIO.—August Herrman, of this city, is at the head of a project to build a line from this city to Rising Sun and Dillsboro, Ind. It is the plan to enter the city over the tracks of the Cincinnati, Lawrenceburg & Aurora Railway from Sedamsville.

CLEVELAND, OHIO.—Hugh Blakely, one of the promoters of the Cleveland & New Baltimore Traction Company, states that the road will be built. It will touch Mantua and Ravenna and will connect at New Baltimore with the Akron-Alliance Connecting Railway.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Railway Company is considering the advisability of increasing its capital stock from $1,600,000 to $2,000,000. It appears that the construction of the Norwalk extension cost more money than originally estimated.

CLEVELAND, OHIO.—The majority of the steam roads throughout Ohio have announced that the competition of electric roads has made it necessary to make a rate of one fare for the round trip, during the holidays, between points where the electric line competition is the strongest.

CLEVELAND, OHIO.—J. B. Perkins, a well-known electrical engineer of Toledo, is preparing plans for the erection at Painesville, Ohio, of a large power house for the Cleveland, Painesville & Ashtabula Railway. When completed it will probably be used to supply the Cleveland, Painesville & Eastern Railway as well.

TOLEDO, OHIO.—W. B. Strang, contractor of the Detroit & Toledo Shore Line has arranged for the sale of the overhead equipment at present standing on the road, to the Toledo & Monroe Railway which will proceed as soon as possible to extend its line from Monroe to Detroit. It is now generally believed that when the line is completed it will be absorbed by the Detroit United Railway.

CLEVELAND, OHIO.—The Cleveland & Sharon Traction Company, which was originally incorporated for $10,000, will increase its capital stock to $1,000,000 and the permanent organization will be effected. At the same time a contract will be placed with the Morgan Mining & Engineering Company for the construction of the first six miles of road from Middlefield to Mesopotamia. The Osborn Engineering Company, Cleveland, will be the consulting engineers.

CLEVELAND, OHIO.—The Cleveland, Akron & Southern Fast Line Company has been incorporated by C. R. Grant, Thomas L. Childs, George W. Seiber, and Robert Hertzer. The company proposes to build an electric railway from Cleveland to Akron and Massillon, with a branch to Canton. This is a distinct project from the Cleveland, Richfield & Akron Railway Company,

which aims to build a new line from Cleveland to Akron. Both companies claim to have secured right of way.

CLEVELAND, OHIO.—The gross earnings of the Cleveland Electric Railway Company have increased $158,000 thus far this year and it is estimated that the earnings for the year will be $200,000 more than last year. At the present time the company is doing a large amount of rail welding. The addition to the Cedar Avenue power station is about completed, but the units will not be installed for about a year. In the meantime it is probable that the company will erect two and perhaps three storage battery stations.

TOLEDO, OHIO.—It is stated that Spitzer & Company, local bankers, have acquired control of the Jackson & Battle Creek Traction Company. It is proposed to issue $1,400,000 of bonds which will be offered at a fair figure with a 50 per cent. stock bonus. At present the company has a capital stock of $1,200,000 and bonds to the same amount. Of the bonded indebtedness $200,000 is put up with the Savings & Trust Company, Cleveland, as trustee, as a reserve fund. It is probable that Gen. C. M. Spitzer will be elected president and A. L. Spitzer, vice-president.

SPRINGFIELD, OHIO.—An unusual traffic arrangement has been perfected between the Erie Railway (steam) and the Dayton, Springfield & Urbana Railway (electric). The main line of the Erie passes through Durbin, several miles from Springfield. The steam road is planning to build a spur line into the city, but until it is completed the steam company will operate a special car over the electric line into the city. A new car is being built for the purpose. It will be a regular steam passenger coach so far as size and accommodations are concerned, but it will be equipped for electric propulsion and it will connect with all Erie trains.

DAYTON, OHIO.—A plan for the formation of an important traction system radiating from this city is brought to light in the recent incorporation of the Dayton Eastern Consolidated Traction Company with a nominal capital stock of $10,000, by D. King Gotwold and L. B. Corey, of Springfield, M. L. Mowser, of Dayton, and Charles Orr, of Cleveland. These gentlemen are interested in proposed lines known as the Springfield & Washington Traction Company and Xenia & Wilmington Traction Company. It is claimed that both of these projects have been financed and Eastern capitalists stand ready to build the roads. It is proposed, however, to consolidate the two projects with the Dayton & Xenia Traction Company which operates two lines from Dayton to Xenia and a branch line to Spring Valley and an option is said to have been secured on these roads. By the consolidation of these properties there would be a line from Dayton to Washington C. H., by way of Xenia and Jamestown, also a line from Springfield to Wilmington, by way of Clifton and Jamestown. It is stated that the parties interested in the proposed roads have agreed to a plan of consolidation and that if it goes through, the new lines will be built at once.

EASTON, PA.—The Easton and Nazareth Street Railway Company and the Easton, Tatamy and Bangor Street Railway Company, two of the leading trolley lines in Easton and vicinity, have been consolidated, and hereafter will be operated as the Northampton Traction Company.

NASHVILLE, TENN.—The Nashville Street Railway Company announces that it will expend $1,000,000 in improvements.

KNOXVILLE, TENN.—Philadelphia capitalists are interested in a scheme to connect the towns of Bristol and Rogersville by an electric railway which is to pass through Kingsport. At the latter place is to be built the power house and the Holston River is to be utilized to generate the electric power.

FORT WORTH, TEX.—The Northern Texas Traction Company, which operates the interurban electric line between Fort Worth and Dallas, announces that it will build an extensive system of interurban lines in that part of Texas, all of the proposed lines to radiate from Fort Worth. The new lines aggregate more than 125 miles. The cost of building and equiping these proposed new lines is estimated to exceed $3,000,000.

SALT LAKE CITY, UTAH.—Utah capitalists are about starting a new line of electric railway from Cisco to the mines at Moab, Utah, for the purpose of transporting ores from the mines, many of which have heretofore been unprofitable on account of the distance from a railway shipping point. The road will be about 100 miles long and it is estimated will cost about $1,000,000.

SALT LAKE CITY, UTAH.—The incorporators of the new power company at Shoshone Falls, Idaho, propose to build an electric railway from the town of Shoshone Falls to the Falls, a distance of 25 miles. It is also expected to eventually extend the line to the Wood River gold fields and that the mines will be operated by electric power. Mr. J. S. Fuller, of Shoshone Falls, is interested in the project.

MERIDA, MEX.—A company of Mexican capitalists has been organized in this city to construct and operate a central power station for operation of the proposed electric urban and suburban street railway lines.

CITY OF MEXICO, MEX.—Messrs. Jose Garcia and Diaz Rugama, of the City of Mexico, have a concession to construct and operate a suburban line of tramway in the Federal District. The construction of the road is now in progress.

GUADALAJARA, MEX.—The Jalisco Development Company, of Guadalajara, proposes to immediately construct an electric railway between Guadalajara and Chapala, a distance of about thirty miles. The officers of the company are: President, J. M. Chavez; vice-president, J. M. Zermeno; treasurer, Ernesto Mora, all of Guadalajara.

MONTEREY, MEX.—A general meeting of the stockholders of the Empresa Street Car Company, of Monterey, Mexico, is to be held at an early date for the purpose of considering the question of converting the lines of that company into an electric system. It is stated that either this improvement will be decided upon or the property will be sold to the syndicate of Baltimore, Md., capitalists who recently acquired the Slayden street railway system in that city.

SAN LUIS POTOSI, MEX.—An American syndicate is negotiating for the purchase of the street railway system of San Luis Potosi. The system is owned by the Compania de Tramvias, Limitada, the shares all being held by residents of that city, most of the stockholders being Spanish capitalists. All that is at present known is that the parties are in consultation and that the company has named its price which will probably be accepted. San Luis Potosi has a population of about 80,000 people and is a commercial and industrial center of much importance.

TORONTO, ONT.—The shareholders of the Toronto Street Railway Company have decided to increase the capital stock of the company from $6,000,000 to $7,000,000. It is generally understood that the new issue is for the purpose of purchasing such outside electric lines as are not now under the control of the company. It is said to be likely, however, before anything definite is done in the matter, that the company will first have electrical energy transmitted from Niagara Falls to Toronto, and it is stated that the arrangements for such transmission are near completion.

NEW INDUSTRIAL COMPANIES.

THE PHILADELPHIA ELECTRIC COMPANY has been chartered at Harrisburg, Pa., with a capital of $100,000.

THE HARBOTH-MITCHELL COMPANY, of Wilmington, Del., has been chartered to conduct business as electrical and mechanical engineers. Capital, $125,000.

THE KANSAS-OKLAHOMA TELEPHONE & ELECTRICAL SUPPLY CO., Sabetha, Kan., capital $10,000 has been incorporated by B. F. Herring, J. H. Judy, W. C. Buck and others.

THE EDGETON ELECTRICAL MOTOR MANUFACTURING COMPANY, of Philadelphia, has been chartered at Dover, Del., to manufacture electric motors. Capital, $300,000.

THE IMPERIAL AUTOMOBILE COMPANY, LTD., has been incorporated at Detroit, Mich. Mr. J. B. Book is chairman of the board of managers and Mr. R. O. Adams is secretary.

THE BRISTOL MOTOR CAR COMPANY, capital $10,000, has been organized in Bristol, Conn. Frederick N. Manross is president; W. L. Newbauer, treasurer; E. B. Burwell, secretary.

THE DAVIS ELECTRIC MANUFACTURING COMPANY, with a capital stock of $50,000, has been incorporated in New Jersey by Raymond Newman, Horace S. Gould and Kenneth K. McLaren.

THE CINCINNATI ELECTRICAL TOOL COMPANY, of Cincinnati, Ohio, has been incorporated with $15,000 capital stock by W. G. Benninger, J. W. Zimerer, John G. Appel, George A. Appel and Charles A. Appel.

THE O'ROURKE ENGINEERING CONSTRUCTION COMPANY, of New York, has been incorporated with a capital stock of $1,000,000. The directors are Millard F. Tompkins and Henry G. Colvin, of New York City.

THE RICHMOND ELECTRIC MANUFACTURING COMPANY, of New York, has been incorporated with a capital stock of $2,000. The directors are R. F. Sievert and Matilda Sievert, of Staten Island, and A. W. Plassman, of New York.

THE H. P. CAMERON ELECTRICAL MANUFACTURING COMPANY, of Ansonia, Conn., has been chartered, capital $50,000. David Dawson is president; H. P. Cameron, vice-president; Irving Whiting, treasurer; John Elliott, Jr., secretary.

THE CRESCENT ELECTRIC COMPANY, Utica, N. Y., has filed articles of incorporation at Albany. It has a capital stock of $30,000. The company is composed of former employees of the Utica Fire Alarm Telegraph Company who left its employ during the strike two months ago.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, has been incorporated under the laws of Delaware with $50,000 capital stock. The company takes over the partnership which for the past twelve years has manufactured a line of oil filters. The new officers are W. F. Warden, president and general manager; H. F. Maranville, vice-president; H. J. Blackburn, secretary-treasurer.

LEGAL.

WESTERN UNION STAYS ON ROAD.—By a decision handed down Nov. 3 by Judge Thayer of the U. S. Circuit Court of Appeals at St. Paul the Great Northern Railway Company is defeated in its suit to oust the Western Union Telegraph Company from the railroad right of way. The matter has been in litigation ten years. The court held that the contract which the telegraph company had with the railroad is for a perpetual right of way and not to be disrupted. The railroad is entitled to the cost of transporting all materials which the telegraph company uses in the construction of its lines. Should the two companies fail to agree upon the amount due for transporting construction materials, the court will appoint a master in chancery and two commissioners to take testimony and report and the court will then pass on the matter. The litigation involves 825 miles of line built prior to 1892.

PERSONAL.

MR. W. SELLERS, an electrical engineer of Berlin, Germany, is now on a visit to this side. Last advices said he was in Pittsburg.

MR. GEORGE L. CRAGG, patent lawyer, Chicago, announces that the entrance to his offices in the Monadnock Building will be at room 1453.

MR. NORTON P. OTIS, the chairman of the board of directors of the Otis Elevator Company, has been elected to Congress on the Republican ticket.

MR. RALPH D. MERSHON now has his headquarters as consulting electrical engineer in the Columbia Building, 29 Broadway, New York City.

MR. FRANK W. HASKELL, president of the Carborundum Company, of Niagara Falls, is up for membership in the Automobile Club of America.

MR. H. F. A. KLEINSCHMIDT gave a lecture a few evenings ago before the Engineers' Club at Columbus, Ohio, on the subject "The Electric Welding of Rails."

MR. L. G. MARTIN, of the Okonite Company, is in San Francisco in connection with the installation of the San Francisco-Honolulu cable by the commercial Pacific Cable Company.

DR. OTTO C. STRECKER, of Darmstadt, Germany, is on a short visit to this country, during which he will inspect some of the more important American electrical plants and manufacturing works.

MR. FREDERICK J. NEWMAN is now chief engineer of the Woods Motor Vehicle Company, Chicago. Mr. Joseph Ledwinka has taken over his engineering practice with offices in Pittsburgh and Chicago.

MR. FRED H. POTTER, of New York, has been visiting Key West in the interest of a New York syndicate examining the property of the Key West Electric Light Company, with a view to purchasing and largely increasing the plant.

MR. CHARLES CUTTRISS, chief electrician of the Commercial Pacific Cable Company, has arrived in San Francisco, where he will have supervision of the arrangements for completing the San Francisco end of the new Honolulu cable system.

MR. CHARLES W. DOUGLASS, for thirty-seven years chief clerk in the office of the superintendent of the Western Union Telegraph Company, at Cleveland, has resigned to go into manufacturing business. Mr. Douglass is widely known in the telegraphic business.

MR. F. E. DRAKE, who for two or three years past has been the efficient manager of the Union Elektricitäts Gesellschaft, at Berlin, has definitely closed up his work there and will return to this country some time in December. It is understool he will remain here.

MR. HENRY A. LARDNER, electrical engineer with the J. G. White Co., one of the officers of the New York Electrical Society and a member of the American Institute of Electrical Engineers, was married recently at Grace Chapel, New York, to Miss Ethel Anna Elmore.

MR. A. FREDERICK COLLINS recently delivered a lecture on "Wireless Telegraphy" before the Woman's Club of Englewood, N. J., and has delivered the first of a number of lectures on the same subject in a course under the auspices of the New York City Board of Education.

MR. HENRY A. EVERETT, of Cleveland, has been elected president of the Toledo Railways & Light Company, Toledo, Ohio, to succeed Albion E. Lang, who is retiring from business. Mr. Everett recently resigned the presidencies of the Federal Telephone Company and the Cuyahoga Telephone Company, as announced in our last issue.

MR. W. H. WILEY, the well-known New York publisher and engineer, has been elected to Congress as a Republican, from one of the New Jersey districts. The House receives a valuable acquisition and a host of Mr. Wiley's friends are heartily glad to see this popular recognition of his many sterling qualities of heart and mind.

MESSRS. A. C. RAHE and M. O. SMITH, of the Smith Storage Battery Company, Binghamton, N. Y., were visitors to New York last week. The interest which their novel cell has aroused is responsible for many inquiries that have reached this company. Their energy has converted the inquiries into orders and business is very brisk.

MR. ELGIN E. STODDARD, sales manager of the engineering firm of Chas. C. Moore & Co., of San Francisco, is in the East and while in New York was a caller at the offices of ELECTRICAL WORLD AND ENGINEER. The concern has been very busy in plant installation, etc., and reports active conditions in the electrical field on the Pacific slope.

MR. A. M. LITTLE, formerly secretary of the American Electric Company, St. Paul, Minn., and traveling salesman for the Western Electric Company, Chicago, Ill., and who has, during the past year, been the New York State representative for Stuart-Howland Company, Boston, Mass., has entered the employ of Pass & Seymour, Inc., Solvay, N. Y., to represent them in the factory territory.

MR. W. H. STOCKS, who has been master mechanic of the Chicago, Rock Island & Pacific Railroad for several years, has resigned from that company to accept an appointment as representative of Gold Car Heating and Lighting Company, of New York, Chicago and London. Mr. Stocks has been associated with the mechanical departments of Minneapolis and St. Louis Railway, Great Northern Railway and Chicago, Rock Island & Pacific Railway for twenty-five years, during which time he has held the position of foreman, general foreman and master mechanic of the roads mentioned.

MR. FRANK J. SPRAGUE, who had been at the Savoy Hotel for some days, is announced by the London cablegrams to have gone to Paris. Before leaving, Mr. Sprague had something to say about the coming electrification of London. He does not think highly of present legislative conditions, which allow private persons to control London's transportation problems. In his opinion the London County Council or some strong committee should have power to execute a well ordered scheme of rapid transit, either by itslf or through private enterprise. He predicts that the day is not far distant when the steam locomotive will be unknown in and around London. At first, he says, there will be electricity for suburban lines and steam for long distance expresses and goods trains, but soon it will be found quicker and more convenient to work all railroad traffic by electricity up to a radius reaching beyond the suburban area. In Mr. Sprague's opinion the general adoption of electricity by English railways is coming much more quickly than most people realize. This will introduce a new condition of life, and one which will make for the health and happiness of the millions who earn their living in the big cities of the United Kingdom.

NEW INSTITUTE MEMBERS.—At the last meeting of the directors of the American Institute of Electrical Engineers, the following new associates were elected: Beattie, Mark Brewer, General Electric Co., 706 Phœnix Building, Minneapolis, Minn. Bainton, John Richard, Consulting Engineer, Edge and Edge, 250 Pitt St., Sydney, New South Wales. Collins, Curtis C., Electrical Engineer, S. A. Luz Electrica, Box 244, San Juan, P. R. Copp, Frank Toulmen, Jr., Testing Department, General Electric Co., Schenectady, N. Y. Davis, William Griffith, Power and Mining Eng. Department, General Electric Co., Schenectady, N. Y. Dudley, Eugene Elmer, Chief Electrician, American Steel and Wire Co., Georgetown, Worcester, Mass. Fairchild, Walter Lowe, Sales Engineer, Stanley Electric Mfg. Co., 29 Broadway, New York City. Godbe, Murray Charles, Department Engineer, Utah Light and Power Co., Salt Lake City, Utah. Goody, Coral Payne, Assistant Engineer, The Telluride Power Co., Logan, Utah. Gray, Guthrie, Assistant Mechanical Engineer, Department of Works, World's Fair, St. Louis, Mo. Hall, Frank Wells, Office Engineer, The Sprague Electric Co., Fisher Building, Chicago, Ill. Hamilton, James Henry, Electrical Signaling Engineer. The Cape Government Railways, Cape Town, South Africa. Haselden, Harry Ariel, Electrical Engineer, The Whitin Machine Works, Whitinsville, Mass. Henderson, John Samuel, Superintendent and Electrician, City Electric Light Plant, Brewton, Ala. Herbert, Edward, Western Electric Co., 259 South Clinton St., Chicago, Ill. Hoxie, Hall Farrington, Electrical Engineer, Board of Patent Control, residence 96½ Hicks St., Brooklyn, N. Y. Jacobson, Julius R., Special Employee General Electric Co., Schenectady, N. Y. Johnston, Richard Harry, Assistant, R. D. Lillibridge, 170 Broadway, N. Y. Jolly, John MacCallum, Electrical Engineer, Noyes Bros., 109 Pitt St., Sydney, N. S. W. Jones, Benjamin Needham, Electrician, Marine Eng. and Machine Co., Harrison, N. J. Jones, Robert Clay, Turnbull & Jones, Electrical Engineers and Contractors, Box 362, Dunedin, New Zeal. Joslin, Arba Vanderburg, Transformer Inspector, Ind. Electric Light and Power Co., San Francisco, Calif., Kappella, Adolph Somers, Head of Induction Motor Tests, General Electric Co., Schenectady, N. Y. Livers, John Leo, Electrical Contractor, Martinsburg, W. Va. Lodyguine, Alexander, Electrical Engineer, National Battery Co., 359 Normal Ave., Buffalo, N. Y. MacKeen, Rupert Thomas, Assistant Superintendent of Construction, The Canadian General Electric Co., Toronto, Ont. Medbury, S. C., Jr., Electrical Engineer of Stations, Va., Passenger and Power Co., 116 N. 3d St., Richmond, Va. Nesbit William, Salesman Westinghouse E. & M. Co., 902 University Block, Syracuse, N. Y. Replogle, James Gillespie Blaine, Superintendent, The South Fork Electric Light Co., Box 164, South Fork, Pa. Scott, Robert Julian, Professor of Engineering and Electricity, New Zealand University, Canterbury College, Christchurch, New Zealand. Stone, Charles Leroy, Power and Mining Department, General Electric Co., Schenectady, N. Y. Waters, William Lawrence, Chief Engineer, Christensen Eng. Co., Milwaukee, Wis. Williamson, Robert Baird, Principal of School of Electrical Engineering, The International Correspondence Schools, Scranton, Pa. Woolford, William Allen, Testing Department, General Electric Co., Schenectady, N. Y. Mr. G. W. Greenwood was transferred to full membership.

EDUCATIONAL.

LOWELL LECTURE COURSES.—In the Lowell free lecture courses at the Massachusetts Institute of Technology, twelve lectures on general electrical testing are to be delivered by Asst. Prof. F. A. Laws and twelve on polyphase currents by Prof. H. E. Clifford.

GROWTH OF CORNELL UNIVERSITY.—President Schurman, of Cornell University, has announced the results of the deliberations of the annual Fall meeting of the Board of Trustees of the university. An increase in facilities for instruction, in which are included gifts from the late Dean Sage, of Albany, Hiram W. Sibley, of Rochester, the late James B. Guilford, of Utica, and Cornelius N. Bliss, Henry R. Ickelheimer, George C. Boldt, Jacob H. Schiff, John D. Rockefeller, and Oliver H. Payne, of New York, were announced. The location of the Rockefeller Hall of Physics, which will cost $250,000, was decided upon, and the building will be placed on a line running east and west between the present Lincoln and McGraw Halls. President Schurman's recommendation of immediate erection of a hall for arts and humanities, to cost $250,000, was adopted, and the building was located on the plot of ground now occupied by houses of profs. Wait, Law, and Hewett. The plan for the expansion of Cornell University on most magnificent lines was adopted, and for this purpose the president was authorized to purchase immediately sixteen acres of land to the west of the library building. It is proposed to erect six new costly buildings on this plot immediately, and eight more in the remote future. A scheme for the superannuation of all professors at the age of seventy was adopted, the details to be arranged later. It is probable that all professors so retired will be pensioned.

Trade Notes.

MR. HENRY D. SEARS has moved his office in Boston to the Board of Trade Building, 131 State Street.

THE CROUSE-TREMAINE CARBON COMPANY has moved its general offices from Fostoria to Cleveland, Ohio.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has recently issued a new general catalogue dated 1903, and is distributing the same to the trade throughout the country.

WHITEHEAD MACHINERY COMPANY, of Davenport, Ia., is making a specialty of the purchase and sale of second-hand Corliss engines, automatic engines, boilers, etc., and will be glad to receive inquiries on the subject.

A GOLD MEDAL.—At the Dusseldorf Exhibition, which has just terminated, the highest award of merit, the gold medal, was awarded the "Hunt" conveyor. This conveyor is manufactured by the C. W. Hunt Company, West New Brighton, New York.

DISTRIBUTION OF LIGHT.—A dainty and altogether admirable little pamphlet on the distribution of light from the Nernst lamp has just been put in circulation by the Nernst Lamp Company, of Pittsburg. The "talking points" of the Nernst are well brought out.

THE TELEPHONE MAGAZINE, according to the latest announcement of its editor, C. E. Kammeyer, will in the future be published by the Telephone Magazine Publishing Company, with John R. Dare as president. It is announced that no one connected with manufacture of telephone apparatus now has any financial interest in the paper.

ELECTRIC BLUE PRINTING.—The Pittsburg Blue Print Company, 1501 Park Building, Pittsburg, Pa., has issued a pamphlet describing its system of apparatus for blue printing with aid of the electric arc. This company has devised what appears to be a very efficient and convenient arrangement for utilizing the electric arc for this purpose.

OIL FILTERS FOR BATTLESHIPS.—The Burt Manufacturing Company, of Akron, Ohio, has just closed a contract for four large special style Cross oil filters to be used on four new battleships now being built for the Government. In this connection the Burt Company calls attention to the fact that its filters have now been adopted by ten different governments.

THE ECONOMICAL ELECTRIC LAMP COMPANY, 123 Liberty St., New York, reports the sales for its turn-down incandescent electric lamps to be most encouraging; up to date the demand having far exceeded the supply. Recent additions to its facilities, however, enable it to fill orders more promptly. Orders have been received from all parts of the world, some reaching as high as 25,000 lamps. This company recently placed a contract with the Bryan Marsh Company for 175,000 lamps.

SEDERHOLM BOILERS.—The Sederholm boilers are made for high pressures and in large units, by the Allis-Chalmers Company, Chicago, Ill. It is stated that the Sederholm boiler combines the advantages of the horizontal tubular and the French types without possessing their defects. The principal features claimed for this boiler are economy, durability and concentration of power. The Allis-Chalmers Company has recently sent out some literature on the subject of this boiler, including a report of a test made last year. The company will be glad to send this matter to any address upon application.

ELECTRICAL SUPPLIES.—In some trade catalogues one finds illustrated many devices that are of little practical value. A catalogue gotten up with the idea of quality of contents rather than quantity is therefore likely to prove of especial interest. The Vallee Bros. Electrical Company, 625 Arch Street, Philadelphia, has adopted this plan in the production of two late catalogues, Nos. 4 and 5, the first of which relates to electrical house goods and the second to telephone apparatus. Only articles of approved value are listed and even they make catalogues of large size. The articles illustrated are up-to-date, and there is a satisfaction in feeling that in looking the catalogues over no time is wasted in noting records of obsolete or useless goods. All of the apparatus listed in these catalogues are standard. The company deals in everything electrical and does not confine itself to the two departments above mentioned.

THE VILTER MANUFACTURING COMPANY, Milwaukee, Wis., builder of improved Corliss engines, has recently received a letter from one of its customers which reads as follows: "Mr. Banes tells me that you have completed the installation of the tandem compound Corliss engine, which I purchased from your people, and I have great pleasure in handing you herewith my check to cover your services in full. The opinions of all of the engineers and electrical people who have inspected my plant have been that the engine is a splendid piece of work, admirably adapted to my requirements in every respect and my engineer, Mr. Banes, tells me that it performs perfectly. I have no doubt at all that it will prove most satisfactory, and assure you that I am indebted to you for the very capable manner in which you have conducted the installation. Tom J. Gardner, Las Animas, Colo."

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 4, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

712,477. BRUSH HOLDER; N. C. Bassett, Lynn, Mass. App. filed March 24, 1902. The brush lies against a flange inclined to the radius of the commutator and a coil spring has one end in engagement with the brush and the other with the brush holder.

712,513. OUTLET BUSHING FOR CONDUITS; F. W. Erickson, Boston, Mass. App. filed March 15, 1902. A two-part bushing having external and internal screw-threads, the former for a nut and the latter for the end of the conduit.

712,514. INTERIOR CONDUIT OUTLET BOX; F. W. Erickson, Boston, Mass. App. filed March 26, 1902. The box is cast around the bushings through which the conduit enters.

712,521. REGULATOR FOR ALTERNATING SERIES ARC LIGHT SYSTEMS; J. H. Hallberg, New York, N. Y. App. filed Nov. 27, 1901. An elastically suspended magnet coil and a balanced core; the coil being in series with the line, so that when one or more lamps are cut out, the movement of the core will introduce impedance in the circuit.

712,522. REGULATOR FOR ALTERNATING SERIES ARC LIGHT SYSTEMS; J. H. Hallberg, New York, N. Y. App. filed Jan. 29, 1902. A device for automatically changing the ratio of the current transformation, whereby the power factor of the system will be maintained practically constant from zero to full load.

712,523. REGULATOR FOR ALTERNATING SERIES ARC LIGHT SYSTEMS; J. H. Hallberg, New York, N. Y. App. filed Jan. 29, 1902. Comprises a device, a portion of which is responsive to any increase in current upon the line within predetermined limits and a portion of which is only responsive to a current in excess of such limit, which device will act when energized to introduce an impedance upon the line proportional to any decrease in load.

712,524. REGULATOR FOR ALTERNATING SERIES ARC LIGHT SYSTEMS; J. H. Hallberg, New York, N. Y. App. filed Jan. 29, 1902. A modification of the preceding patent.

712,525. FIRE ALARM SIGNALING APPARATUS; J. Hamer, Buffalo, N. Y. App. filed Nov. 11, 1901. The wrist of the person sending in the alarm is caught and can be released only when someone else arrives with a releasing device.

712,535. METHOD OF CONSTRUCTING ELECTRIC SWITCHES; G. H. Hill, Glenridge, N. J. App. filed Aug. 10, 1901. The contact segments are coated with porcelain or an insulating paint before they are embedded in a base insulation.

712,539. TROLLEY; N. Nublinger, Barberton, Ohio. App. filed July 3, 1902. The wheel is mounted on a short vertical axis, so that it will yield laterally when passing curves.

712,549. MOTOR CONTROLLER; G. E. Krause and A. L. Bolen, Indianapolis, Ind. App. filed Oct. 7, 1901. A set of resistances and means for changing bridging connections between their terminals whereby they may be placed in series or any number in parallel with the remainder in series.

712,561. REGULATION OF DYNAMO-ELECTRIC MACHINES; Alexander D. Lunt, Schenectady, N. Y. App. filed January 17, 1900. (See Current News and Notes.)

712,568. CABLE JOINT; W. M. Murphey, New York, N. Y. App. filed Jan. 13, 1902. A sleeve carrying its own cementing material and applicable to the joint.

712,584. WINDING FOR ELECTRICAL TRANSFORMERS; J. S. Peck, Pittsburg, Pa. App. filed March 21, 1902. A parallel winding for transformers comprising a number of coils severally sub-divided and mutually cross-connected so as to insure the same inductive relation for all of the parallel circuits.

712,589. SYSTEM OF MOTOR CONTROL; William B. Potter, Schenectady, N. Y. App. filed Nov. 1, 1900. Both the motor field and armature are revolvable; one is geared to the car axle and the other is controllable from any point of a car or train by means of a brake actuated by pneumatic or hydraulic means.

712,590. END PLAY DEVICE FOR ROTARY MACHINES; W. B. Potter and E. M. Hewlett, Schenectady, N. Y. App. filed March 27, 1901. Means for regulating end play in rotary machines, comprising a shaft, means for effecting end-thrust and means for maintaining a slow speed of movement during the end-thrust compared with the speed of the shaft.

712,591. COMMUTATOR BRUSH; W. B. Potter, Schenectady, N. Y. App. filed Sept. 9, 1901. The contact end of the brush is reduced in lateral dimensions.

712,600. SWITCHBOARD SOCKET; H. R. Sargent, Schenectady, N. Y. App. filed March 5, 1901. Details.

712,613. ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINE AND SYSTEM OF DISTRIBUTION; William Stanley, Great Barrington and John F. Kelly, of Pittsfield, Mass. App. filed April 5, 1902. (See Current News and Notes.)

712,614. ELECTRICAL GENERATION AND DISTRIBUTION; William Stanley, of Great Barrington, and John F. Kelly, of Pittsfield, Mass. App. filed June 25, 1902. (See Current News and Notes.)

712,618. PROTECTING DEVICE FOR ELECTRIC CIRCUITS; P. H. Thomas, Pittsburg, Pa App. filed Nov. 27, 1899. Comprises one or more series gaps, one or more gaps shunting one or more infusible and non-polarizable current-limiting bodies and a non-polarizable current-limiting body in series with all the gaps .

712,619. ELECTRICAL RELAY; A. T. M. Thomson, Middlesex, England. App. filed Feb. 4, 1901. Details.

712,620. ELECTRIC METER; E. Thomson, Swampscott, Mass. App. filed July 27, 1898. A motor generator and devices controlled by the current generated thereby for opening the supply circuit of the motor generator when its armature reaches a rate of rotation corresponding to the energy to be measured.

712,630. HIGH OR LOW WATER ALARM; C. E. Zimmermann, Syracuse, N. Y. App. filed Dec. 5, 1901. A float carrying a pointer and circuit terminals adapted to be closed at the critical point.

712,634. EXERCISING APPARATUS; R. Aronstein, Goldfield, Colo. App. filed June 18, 1902. An apparatus for drill-striking practice in which a circuit is closed through the body of the person using the hammer, at each blow.

712,639. REGULATING ROTARY CONVERTERS; Ernst J. Berg, Schenectady, N. Y. App. filed March 20, 1899. (See Current News and Notes.)

712,650. BRAKE SHOE; F. E. Case, Schenectady, N. Y. App. filed June 30, 1897. Electrically operated brake shoes provided with means for proportioning the braking effect to the co-efficient of track friction.

712,652. INTERCHANGEABLE HOOD SUPPORT FOR HIGH TENSION ELECTRIC LAMP SERVICE; J. H. B. Conger and C. J. Eichhorn, Newark, N. J. App. filed Jan. 24, 1902. Details.

712,668. GRAVITY BATTERY; W. N. Gove, Philadelphia, Pa. App. filed Jan. 16, 1902. Babbitt metal is used in place of copper in an ordinary gravity battery.

712,673. PROCESS OF OPERATING ELECTRIC MOTORS; J. Harris, Rensselaer, N. Y. App. filed Jan. 23, 1902. Consists in passing a current through a fluid conductor and then through recurring paths to a second

fluid conductor and to line and in using a revolving device whose ends dip into the conducting fluid at intervals in succession, cutting as they revolve the magnetic flux produced by the current in the field circuit.

712,685. SOCKET FOR INCANDESCENT LAMPS; O. E. Kenney, Toledo, Ohio. App. filed May 31, 1902. Details.

712,686. SOCKET FOR INCANDESCENT LAMPS; O. E. Kenney, Toledo, Ohio, App. filed May 31, 1902. Details.

712,715. ELECTROMEDICAL APPARATUS; L. Petich, New York, N. Y. App. filed March 11, 1901. The apparatus including battery, induction coil, etc., is inclosed in a two-part casing which forms the two electrodes or handles.

712,717. ELECTRIC MOTOR; O. H. Pieper, Rochester, N. Y. App. filed Dec. 4, 1901. The primary of a transformer is connected in series with the field windings and the secondary in series with the armature of the motor, so that the magnetic and electric circuits can be so proportioned that the field and armature current are practically in phase.

712,737. COMPOUNDING-ALTERNATOR; Charles P. Steinmetz, Schenectady, N. Y. App. filed August 20, 1897. (See Current News and Notes.)

712,739. ELECTRIC SPARK GENERATOR; J. Struthers, Des Moines, Ia. App. filed March 10, 1902. Details.

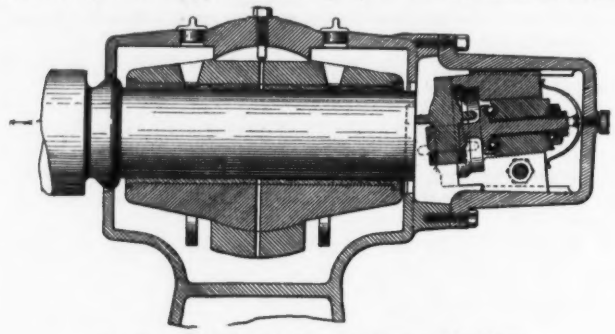
712,741. APPARATUS FOR TRANSFERRING ELECTRIC ENERGY; E. Thomson, Swampscott, Mass. App. filed Feb. 27, 1897. The mode of operation in energizing a core by a winding traversed for a period by the current, then interrupting the current flow by a contact maker at the end of a given time, during which the core has reached a considerable degree of magnetization and at or about the same time closing a circuit secondary to the first winding, to obtain therein a current which may be utilized in any desired way.

712,742. ALTERNATING CURRENT METER; E. Thomson, Swampscott, Mass. App. filed April 10, 1901. A field magnet system provided with a single closed winding connected and arranged to serve at the same time as the series and the potential winding of the meter.

712,749. RHEOSTAT; G. H. Whittingham, New York, N. Y. App. filed Jan. 21, 1902. A tubular insulating body having the resistance coil therein, all terminals of which lead out to one end of the tube.

712,754. RAILWAY SIGNAL; R. A. Baldwin, South Norwalk, Conn. App. filed Dec. 9, 1901. A signaling system in which more than one car or train can pass into a block and yet be protected.

712,764. RECEIVER FOR WIRELESS TELEGRAPHY; Angel De Castro, New York, N. Y. App. filed Dec. 4, 1901. In the antennae circuit is a



712,590.—End-play Device for Rotary Machines.

stretched fine steel wire between the poles of a magnet, surrounded by iron filings and in contact with a sounding box. When the antennae is influenced by electric waves, the device emits a sound, or a galvanometer connected to turns about the magnet is affected. The coherer consists of titanium particles in an exhausted tube, the particles being contained in a cup at the end of one of the tube electrodes, the end of the other electrode bearing on top of the particles.

712,814. BATTERY INSTALLATION FOR SUBMARINE BOATS; S. Lake, Bridgeport, Conn. App. filed March 4, 1902. Cement tanks constructed in metal submarine boats to receive storage batteries.

712,839. SECTIONAL CONDUIT; W. L. McGowan, Philadelphia, Pa. App. filed March 20, 1902. The ends of the sections are united by rods extending into each.

712,845. ELECTRIC SWITCH ACTUATOR; J. Y. Porter, Detroit, Mich. App. filed Aug. 14, 1901. Details.

712,847. DRIVING CENTRIFUGAL OR OTHER MACHINES BY MEANS OF ELECTRIC MOTORS; G. Pott and R. Williamson, Motherwell, Scotland. App. filed Jan. 15, 1902. A stationary spindle, a loose sleeve thereon, to which the armature is fixed, a clutch carried by the sleeve and a disk with which the clutch gradually engages by centrifugal action on starting the motor.

712,871. GRINDING MACHINE; O. S. Walker, Worcester, Mass. App. filed Aug. 12, 1901. An automatic grinding machine in which the circuit of the motor is controlled by the movement of a platen.

712,882. ELECTRICAL CONTROLLER CONTACT ARM; E. H. Wise, Westmont, Pa. App. filed May 20, 1902. Means are provided in the arm for utilizing the current to create a magnetic field to destroy arcs which may be formed on the breaking of the current.

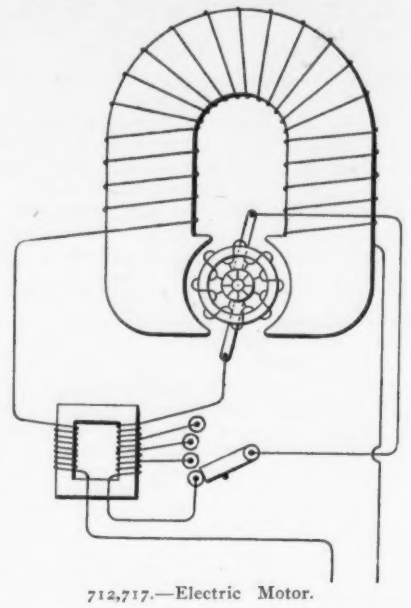
712,939. PRINTING TELEGRAPH; O. L. Kleber, Pittsburg, Pa. App. filed Sept. 10, 1900. Various improvements in printing telegraph apparatus.

712,947. ELECTRIC ARC LAMP; L. C. H. Mensing, London, Eng. App. filed June 30, 1902. Details.

712,961. ELECTRIC RAILWAY SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed March 5, 1900. A transformer adapted to normally supply a current of low potential to the working conductors, a second transformer and a switch actuated by the low potential transformer upon the passage of a car to connect the second transformer so that a current of higher potential will be supplied to the conductor.

712,989. ELECTRIC CAUTERY; W. E. Washburn, Cedar Rapids, Iowa. App. filed Sept. 8, 1902. The device is especially constructed to remove the tonsils.

712,991. REGULATING ROTARY CONVERTERS; Ernst J. Berg, Schenectady, N. Y. App. filed March 20, 1899. (See Current News and Notes.)



712,717.—Electric Motor.

712,994. METHOD OF OPERATING ELECTRIC BRAKES; F. E. Case, Schenectady, N. Y. App. filed June 30, 1897. Electrically actuated brake shoes provided with means whereby any one can be released whenever the speed of rotation of its axle is substantially less than that of another axle.

712,995. PROCESS OF PEROXIDIZING STORAGE BATTERY PLATES; R. N. Chamberlain, Depew, N. Y. App. filed Aug. 23, 1900. The plates are subjected as anodes to electrolysis in a solution of sulphuric acid and nitrate of lead.

712,999. STORAGE BATTERY; B. Ford, Philadelphia, Pa. App. filed Aug. 28, 1900. A flat plate having its edge turned over to form a tubular bead, constituting a support for the active material.

713,005. PENHOLDER; G. B. Hunt, New York, N. Y. App. filed April 7, 1902. The "grip" of the penholder is made up of alternate zinc and copper sections, to afford a galvanic action when it is held between the fingers.

713,010. REGULATING DYNAMO-ELECTRIC MACHINES; Alexander D. Lunt, Schenectady, N. Y. App. filed January 7, 1900. (See Current News and Notes.)

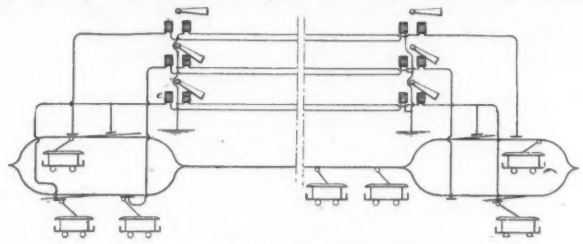
713,015. SURFACE CONTACT STRUCTURE; W. B. Potter, Schenectady, N. Y. App. filed Oct 11, 1897. The contact button can be lifted out of its solid support and easily replaced, there being a conducting socket into which the lower end fits.

713,016. ELECTRIC RAILWAY SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed March 5, 1900. A specific form of apparatus by which the low potential secondary of a transformer is prevented from being short-circuited when the high potential secondary is cut into circuit.

713,020. PROCESS OF MANUFACTURING ELEMENTS FOR STORAGE BATTERIES; E. A. Sperry, Cleveland, Ohio. App. filed Feb. 20, 1902. Process consists in mixing together while dry and in a finely divided condition, lead, lead oxide and an alkali-metal salt and then moistening the mixture with an alkaline hydroxide.

713,022. COMPOUNDING ALTERNATORS; C. P. Steinmetz, Schenectady, N. Y. App. filed August 20, 1897. (See Current News and Notes.)

713,023. ELECTRIC METER; E. Thomson, Swampscott, Mass. App. filed July 27, 1898. A motor, the speed of which is varied by intermittently



712,754.—Railway Signal.

applying energy thereto at such intervals as to maintain its speed proportional to the quantity to be measured.

713,044. METHOD OF PRODUCING ASYMMETRICAL CURRENTS FROM SYMMETRICAL ALTERNATING E. M. F.; Michael I. Pupin, Yonkers, N. Y. App. filed Jan. 4, 1898. The capacity reactance of an electrolytic cell is proportioned to the other reactance in circuit such that when an alternating E. M. F. is impressed on it, one-half of the wave will be suppressed.

713,045. APPARATUS FOR PRODUCING ASYMMETRICAL CURRENTS FROM SYMMETRICAL ALTERNATING E. M. F.; Michael I. Pupin, Yonkers, N. Y. App. filed Jan. 4, 1898. Details for carrying out above method.